- *Final* -

Environmental Assessment for Hypersonic Technology Vehicle 2 Flight Tests

Prepared for: Tactical Technology Office
Defense Advanced Research Projects Agency
Arlington, Virginia

and

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Space and Missile Systems Center
Los Angeles Air Force Base, California

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14. ABSTRACT
This EA documents the potential environmental impacts of conducting two Hypersonic Technology Vehicle 2 (HTV-2) flight tests to support development and demonstration of hypersonic technologies. Both HTV-2 missions would be launched from Vandenberg Air Force Base, California, using existing rocket booster systems. Following booster separation, the HTV-2 would glide at hypersonic velocities in the upper atmosphere, prior to an ocean impact near US Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site in the Republic of the Marshall Islands.

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FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR HYPERSONIC TECHNOLOGY VEHICLE 2 FLIGHT TESTS

AGENCIES: Defense Advanced Research Projects Agency (DARPA) and United States (US) Air Force (USAF)

BACKGROUND: The DARPA and the USAF prepared an Environmental Assessment (EA) to evaluate the potential environmental consequences of conducting Hypersonic Technology Vehicle 2 (HTV-2) flight tests from Vandenberg Air Force Base (AFB) in California (CA) to the US Army Kwajalein Atoll (USAKA)/Ronald Reagan Ballistic Missile Defense Test Site (RTS) in the Republic of the Marshall Islands (RMI). The attached EA, which is hereby incorporated by reference, was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions), Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508), 32 CFR Part 989 (*Environmental Impact Analysis Process*), and the *Environmental Standards and Procedures for US Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands*.

The DARPA and the USAF are researching hypersonic aerodynamics and control systems to enable a wide variety of future capabilities currently unavailable for rapid global response. The HTV-2 is just one step in a series of program flight experiments to explore hypersonic technology and its applications. The purpose of the HTV-2 flight test missions is to demonstrate aerodynamic principles, guidance and control theories, high-temperature materials, and thermal protection systems for long duration, hypersonic flight in the upper atmosphere.

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES: The Proposed Action is to conduct two HTV-2 flight tests to support development and demonstration of hypersonic technologies. As a rocket payload, each HTV-2 test bed vehicle would be launched from Vandenberg AFB using a Minotaur IV Lite booster. Following launch over the Pacific Ocean, the HTV-2 vehicle would separate from the booster and glide at hypersonic velocities in the upper atmosphere towards the USAKA/RTS in the RMI. Upon reaching the terminal end of each flight, the vehicle is expected to impact within the Broad Ocean Area (BOA) approximately 40 to 80 nautical miles (74 to 148 kilometers) north of USAKA/RTS. With the exception of floating debris, there are no plans to recover the HTV-2 vehicles following ocean impact. Both flight tests are scheduled to occur in calendar year 2009. As part of test preparations for each flight test, support vessels and free-floating sensors would be deployed temporarily in or near the BOA impact area, and a mobile, land-based telemetry system might be deployed temporarily to Wake Island. In addition to the Proposed Action, the EA also analyzes the No Action Alternative, which serves as the baseline against which the Proposed Action is evaluated.

ENVIRONMENTAL EFFECTS: The DARPA and the USAF assessed potential impacts of the Proposed Action at Vandenberg AFB, within the over-ocean flight corridor, and at USAKA/RTS and the Marshall Islands. Because environmental issues associated with the proposed HTV-2 flight tests vary widely at each location, the resources analyzed in each case also vary. For Vandenberg AFB, the following resources could be affected and are analyzed in the document: air quality, noise, biological resources, cultural resources, health and safety, and hazardous materials and waste management. For USAKA/RTS, noise, biological resources, and health and safety are analyzed. Within the over-ocean

flight corridor, the global atmosphere and biological resources are assessed. The analyses for each location are summarized as follows.

Vandenberg AFB

Air emission levels from HTV-2 program operations and launches would not exceed *de minimis* (minimal importance) thresholds for criteria pollutants, be regionally significant, or contribute to a violation of Vandenberg AFB's air operating permits. In addition, no exceedances of air quality or health-based standards for non-criteria pollutants are anticipated.

Noise from launches would be infrequent, very short in duration, and have little effect on the CA Community Noise Equivalent Level for this area. Because the launch vehicle flight trajectories would be in a westerly direction, the sonic booms would not impact the mainland or the northern Channel Islands. Based on prior monitoring studies, the rocket launches are expected to have a negligible, short-term impact on seals and sea lions, most sea and shore birds, and other protected species on base. Site modifications would not require excavations or other ground disturbance; thus, activities are not expected to impact known archaeological sites. Modifications and use of historic facilities would be minimal and short term.

The HTV-2 program flight tests represent routine types of activities at Vandenberg AFB. The launches would not lead to Environmental Justice concerns. Allowable public risk limits for launch-related debris would be extremely low. By adhering to established and proven safety standards and procedures, the level of risk to military personnel, contractors, and the general public would be minimal. All program-related hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs are not expected to change.

In terms of cumulative impacts, the two proposed HTV-2 program launches would represent a 10.5 percent increase in the number of launches at Vandenberg AFB in 2009. Each launch, however, represents a short-term, discrete event that occurs at different times and at different locations across the base.

Over-Ocean Flight Corridor and the Global Environment

Regarding potential effects on the global atmosphere, emissions of ozone-depleting substances and greenhouse gases would be negligible compared to anthropogenic releases worldwide. The limited amount of emissions would not contribute significantly to cumulative global warming or stratospheric ozone depletion.

Although the propagation of sonic booms underwater could cause auditory effects in marine animals and sea turtles, the effects are considered insignificant because of the limited area and duration of potential exposure to adverse sound levels, and the low density of animals in the open ocean. The probability for animal injuries from falling rocket debris can also be considered negligible. Because launches over the Pacific Ocean represent discrete events that occur at different times and affect different areas of the ocean, no cumulative impacts to marine life are expected.

USAKA/RTS

Local RMI communities would be exposed to HTV-2 vehicle sonic booms, but only once within each community and at sound levels well within US Occupational Safety and Health Administration standards for impulse noise.

Deployment of vessels and free-floating rafts (with optical and/or acoustical sensors and telemetry equipment onboard) in the BOA would have little or no impact on marine species. Just as for the over-ocean environment, sonic booms are unlikely to adversely affect marine mammals and sea turtles in the BOA. The probability for animal injuries from HTV-2 vehicle impacts in the ocean can also be considered negligible.

HTV-2 test preparations at USAKA/RTS would not introduce new types of activities or increase levels of risk to support personnel. The proposed HTV-2 flight tests and impacts in the Marshall Islands would be conducted using the same USAKA/RTS range safety standards as those applied to other flight-test programs. Allowable public risk limits for flight vehicle debris are extremely low.

As for cumulative impacts, the proposed HTV-2 flight tests and ocean impacts would be conducted in a manner similar to that of other flight-test programs at USAKA/RTS. The two HTV-2 flight tests, however, would have minimal overlap with other programs in terms of affected areas and potential for cumulative impacts.

ENVIRONMENTAL MANAGEMENT AND MONITORING ACTIONS: Although no significant or other major impacts are expected to result from implementation of the Proposed Action, the DARPA and the USAF identified some specific environmental management and monitoring actions to minimize the level of impacts that might occur at Vandenberg AFB and at USAKA/RTS. These activities include use of environmentally preferred and/or recycled materials whenever possible; briefing contractors and base support personnel on the sensitivity of cultural resources; and monitoring for marine mammals and sea turtles during ocean operations. Section 4.4 of the EA summarizes these and other measures to be implemented as part of the Proposed Action.

PUBLIC REVIEW AND COMMENT: At Vandenberg AFB, CA and at USAKA/RTS in the Marshall Islands, the DARPA and the USAF published an availability notice for public review of the Draft EA and Draft Finding of No Significant Impact (FONSI) in local newspapers on or about March 12, 2009, initiating a 30-day review period that ended on April 13, 2009. The DARPA and USAF placed copies of the Draft EA and the enclosed Draft FONSI at local libraries in California and in the RMI. The draft documents were also available over the Internet. Following completion of the public review period, all comments received were considered and recommended changes were incorporated into the Final EA.

POINT OF CONTACT: The point of contact for questions, issues, and information relevant to the EA for HTV-2 Flight Tests is Mr. Thomas Huynh, SMC/EAFV, 483 North Aviation Boulevard, El Segundo, CA, 90245-2808. Mr. Huynh also can be reached by calling (310) 653-1223, by facsimile at (310) 653-1226, or by e-mail at Thomas.Huynh@losangeles.af.mil.

CONCLUSION: An analysis of the Proposed Action concludes that its implementation will not have a significant environmental impact on the human and natural environment, either by itself or cumulatively with other actions. After thoroughly considering the facts herein, the undersigned finds that the Proposed Action is consistent with existing environmental policies and objectives set forth in NEPA and its implementing regulations. Therefore, an Environmental Impact Statement for the Proposed Action is not required.

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT FOR HYPERSONIC TECHNOLOGY VEHICLE 2 FLIGHT TESTS

AGENCY: United States Air Force (USAF)

APPROVED:

SUSAN K. MASHIKO,
Brigadier General, USAF
Vice Commander
Space and Missile Systems Center

18 May 09

DATE

AGENCY: Defense Advanced Research Projects Agency (DARPA)

APPROVED:

ROBERT F. LEHENY
Acting Director, DARPA

19 May 09

DATE

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ACRONYMS AND ABBREVIATIONS

ABRES	Advanced Ballistic Reentry System
AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFSPC	Air Force Space Command
Al_2O_3	Aluminum Oxide
AQCR	Air-Quality Control Region
ASEL	A-Weighted Sound Exposure Level
AST	Office of Commercial Space Transportation
BOA	Broad Ocean Area
C	Celsius
CA	California
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CCC	California Coastal Commission
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbons
CFR	Code of Federal Regulations
CH_4	Methane
CITES	Convention on International Trade in Endangered Species
Cl	Chlorine
ClO	Chlorine Oxide
CNEL	Community Noise Equivalent Level
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CY	Calendar Year
DARPA	Defense Advanced Research Projects Agency
dB	Decibel
dBA	A-weighted Decibel
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EDMS	Emissions and Dispersion Modeling System
EIS	Environmental Impact Statement
EPPSO	Economic Policy, Planning, and Statistics Office
ESA	Endangered Species Act
F	Fahrenheit
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	Feet
gal	Gallon
GCA	Guidance and Control Assembly
GFE	Government Furnished Equipment

GHG	Greenhouse Gases
GMD	Ground-Based Midcourse Defense
H_2	Hydrogen
H_2O	Water
HAER	Historic American Engineering Record
HCl	Hydrogen Chloride
HTV	Hypersonic Technology Vehicle
ICBM	Intercontinental Ballistic Missile
INRMP	Integrated Natural Resources Management Plan
IPF	Integrated Processing Facility
IRF	Integration Refurbishment Facility
IRP	Installation Restoration Program
kg	Kilogram
km	Kilometer
kph	Kilometers per Hour
lb	Pound
lbm	Pound-Mass
LBP	Lead-Based Paint
LCU	Landing Craft Utility
LOA	Letter of Authorization
LTO	Landing and Take-off
m	Meter
MBCA	Migratory Bird Conservation Act
MDA	Missile Defense Agency
mi	Mile
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Areas
mph	Miles per Hour
N_2	Nitrogen
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
nmi	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NO_X	Nitrogen Oxides
NRHP	National Register of Historic Places
NWHI	Northwestern Hawaiian Islands
O	Free Oxygen Atom
O_2	Oxygen
O_3	Ozone
OEPPC	Office of Environmental Planning and Policy Coordination
OSHA	Occupational Safety and Health Administration
OSP	Orbital/Sub-Orbital Program
PAM	Payload Adapter Module
Pb	Lead
PFMC	Pacific Fishery Management Council
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter

PM_{10}	Particulate Matter less than 10 microns in diameter
PPF	Payload Processing Facility
ppm	Parts per Million
psf	Pounds per Square Foot
PTS	Permanent Threshold Shift
RCC	Range Commanders Council
RCRA	Resource Conservation and Recovery Act
RMI	Republic of the Marshall Islands
ROI	Region of Influence
RSS	Raft Scoring System
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SBCAPCD	Santa Barbara County Air Pollution Control District
SEL	Sound Exposure Level
SHPO	State Historic Preservation Officer
SLC	Space Launch Complex
SMC	Space and Missile Systems Center
SMR	State Marine Reserve
SO_2	Sulfur Dioxide
SOC	Species of Concern
sqft	Square Feet
SRS	SRS Technologies
SSI	Spaceport Systems International
STGS	S-band Transportable Ground System
SW	Space Wing
SWI	Space Wing Instruction
TB	Technical Bulletin
tpy	Tons per Year
TTS	Temporary Threshold Shift
TVC	Thrust Vector Control
UES	USAKA Environmental Standards
UNEP-WCMC	United Nations Environment Programme–World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific, and Cultural Organization
US	United States
USAF	US Air Force
USAKA	US Army Kwajalein Atoll
USASMDC/ARSTRAT	US Army Space and Missile Defense Command/Army Forces Strategic Command
USASSDC	US Army Space and Strategic Defense Command
USAV	US Army Vessel
USC	US Code
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USN	US Department of the Navy
VAFB	Vandenberg Air Force Base
VOC	Volatile Organic Compound
WMO	World Meteorological Organization
XR	Developmental Planning Directorate
$\mu g/m^3$	micrograms per cubic meter
μPa	microPascal

1.0 PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

In a joint effort, the Defense Advanced Research Projects Agency (DARPA) and the United States (US) Air Force (USAF) Space and Missile Systems Center (SMC), Developmental Planning Directorate (XR), propose to conduct two experimental flight tests of the Hypersonic Technology Vehicle 2 (HTV-2). Flight-testing the test bed vehicle would support US development of hypersonic technologies for a wide variety of future aerospace capabilities currently unavailable.

Both HTV-2 missions would be launched from facilities at Vandenberg Air Force Base (AFB), California (CA), using existing rocket booster systems. Following booster separation, the HTV-2 would glide at hypersonic velocities in the upper atmosphere, prior to an ocean impact near US Army Kwajalein Atoll (USAKA)/Ronald Reagan Ballistic Missile Defense Test Site (RTS) in the Republic of the Marshall Islands (RMI). This Environmental Assessment (EA) documents the results of a study of the potential environmental effects resulting from these two flight tests.

The Purpose of an Environmental Assessment

An Environmental Assessment (EA) is prepared by a Federal agency to determine whether an action it is proposing would significantly affect any portion of the environment.

The intent of an EA is to provide project planners and Federal decision-makers with relevant information on the impacts that a proposed action might have on the human and natural environments.

If the study finds no significant impacts, then the agency shall record the results of that study in an EA and publish a Finding of No Significant Impact (FONSI). The agency may then proceed with the action.

However, if the results of the EA indicate that there would be potentially significant impacts associated with the action, then the agency must issue a Notice of Intent and prepare an Environmental Impact Statement (EIS).

In support of the DARPA and the SMC/XR, the SMC Environmental Management Branch of Acquisition Civil/Environmental Engineering determined that an EA is required to assess the potential environmental effects from the launch preparations, flight tests, and post-test activities associated with the HTV-2. This EA was prepared in accordance with the following regulations, statutes, and standards:

- National Environmental Policy Act (NEPA, 1969)
- Executive Order 12114 (*Environmental Effects Abroad of Major Federal Actions*) (Office of the President, 1979)
- The President's Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508) (CEQ, 2007)
- *Environmental Impact Analysis Process* (32 CFR Part 989) (USAF, 2007a)
- *Environmental Standards and Procedures for US Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands*, 10th Edition (US Army Space and Missile Defense Command/Army Forces Strategic Command [USASMDC/ARSTRAT], 2006), hereafter referred to as the USAKA Environmental Standards or UES

- The Compact of Free Association, as Amended, between the Government of the United States of America and the Government of the Republic of the Marshall Islands, signed into law by President George W. Bush, December 17, 2003 (48 United States Code [USC] 1921).

1.2 BACKGROUND

In May 2003, the DARPA established a memorandum of agreement with the USAF to initiate the *Falcon* program—a technology development program to address high priority mission areas and applications, including global presence and space lift. As part of the *Falcon* program, the DARPA and the USAF are researching hypersonic aerodynamics and control systems to enable a wide variety of future capabilities currently unavailable for rapid global response. Research for the development and demonstration of hypersonic technologies will include high lift-to-drag technologies; high temperature materials; thermal protection systems; and guidance, navigation, and control. The HTV-2 is just one step in a previously planned series of *Falcon* program flight experiments to explore hypersonic technology and its applications.

1.3 PURPOSE OF THE PROPOSED ACTION

The *Falcon* program provides for the development of a hypersonic technology test bed vehicle for validating in-flight, hypersonic technologies. The purpose of the two HTV-2 flight test missions is to demonstrate aerodynamic principles, guidance and control theories, high-temperature materials, and thermal protection systems for long-duration, hypersonic flight in the upper atmosphere.

1.4 NEED FOR THE PROPOSED ACTION

An objective of the *Falcon* program is to focus on hypersonic technology development and spur progress in this critical area for our nation's defense. The program's HTV flight tests are needed to validate theoretical models for hypersonic aerodynamics, and guidance and control techniques. As part of the incremental demonstration of this technology, the HTV-2 represents just one of a series of hypersonic technology test beds to be used to verify baseline technologies for future flight tests.

1.5 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA documents the environmental analysis of conducting two HTV-2 flight tests to support development and demonstration of hypersonic technologies. As a rocket payload, each HTV-2 test bed vehicle would be launched from Vandenberg AFB using a Minotaur IV Lite booster. Following launch over the Pacific Ocean, the HTV-2 vehicle would separate from the booster and glide at hypersonic velocities in the upper atmosphere towards the USAKA/RTS in the RMI. Figure 1-1 shows the geographic locations of these sites. Upon reaching the terminal end of each flight, the vehicle would impact within the Broad Ocean Area (BOA) approximately 40 to 80 nautical miles (nmi) (74 to 148 kilometers [km]) north of USAKA/RTS. Plans are to conduct both flight tests in the calendar year (CY) 2009 timeframe.

The EA analyzes the potential environmental effects that might result from rocket motor transportation, pre-flight preparations, flight tests, ocean impacts, and post-test activities associated with the two HTV-2 missions. For both flight tests, existing support buildings and facilities would be used with limited modifications required.

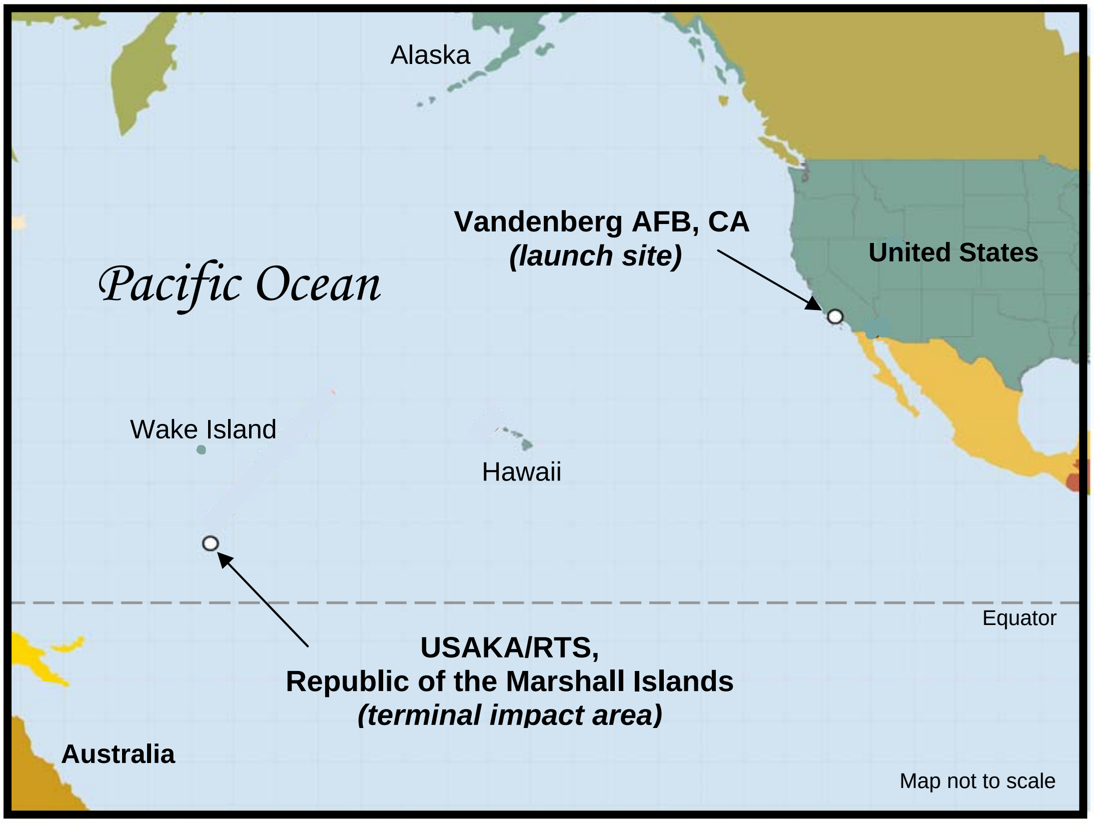

Figure 1-1. Locations for Proposed Hypersonic Technology Vehicle 2 Flight Tests

Per the CEQ and USAF regulations for implementing NEPA (40 CFR 1502.14(d) and 32 CFR 989.8(d), respectively), this EA also analyzes the No Action Alternative that serves as the baseline from which to compare the Proposed Action. Under the No Action Alternative, the two HTV-2 flight tests would not be conducted.

1.6 RELATED ENVIRONMENTAL DOCUMENTATION

The Acquisition Civil/Environmental Engineering Branch, Space and Missile Systems Center, Los Angeles AFB, relied heavily on existing NEPA documents to prepare this EA. These documents are listed below and cited in the EA where applicable:

- *Final Environmental Assessment for Minuteman III Modification* (USAF, 2004)
- *Final Environmental Assessment for the Orbital/Sub-Orbital Program* (USAF, 2006).

1.7 DECISIONS TO BE MADE

Supported by the information and environmental analysis presented in this EA, the DARPA and the USAF will decide whether to conduct the two HTV-2 flight tests, or to select the No Action Alternative. If the HTV-2 missions proceed, decisions on how to implement the tests will depend on individual

mission needs, range requirements, test asset availability, and other logistical considerations and constraints.

1.8 INTERAGENCY COORDINATION AND CONSULTATIONS

Ongoing interagency coordination is integral to the preparation of this EA. For the analysis effort, the USAF requested support from the USASMDC/ARSTRAT as a cooperating agency because of the potential for HTV-2 activities to adversely affect biological and other environmental resources at USAKA/RTS. Written correspondence from both the USAF and USASMDC/ARSTRAT regarding this agreement is provided in Appendix A (pages A-2 and A-4).

Beginning in June 2007, the DARPA and the USAF entered into pre-consultation discussions with the Pacific Islands Regional Offices of the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), both located in Honolulu, Hawaii. Pursuant to the requirements of the USAKA Environmental Standards, the DARPA and the USAF (with USASMDC/ARSTRAT support) held meetings and teleconferences with the agencies to discuss the potential for environmental effects from the proposed HTV-2 flight test activities along the over-ocean flight corridor and in the Marshall Islands. The discussions also served to identify possible mitigation measures to minimize the effects on biological resources.

In May 2008, the USAF provided the USFWS and NMFS Pacific Islands Regional Offices with an earlier draft copy of this HTV-2 EA (dated May 2008) for their review and in preparation for pre-consultation meetings held on June 4, 2008 in Honolulu. In response to the June 2008 meeting and follow-on correspondence, the USFWS Pacific Islands Office provided comments on the earlier draft HTV-2 EA. In their letter dated August 14, 2008 (see Appendix A, page A-5), the USFWS concluded that the Proposed Action is not anticipated to result in significant impacts on fish and wildlife resources. Although the USFWS had concerns over potential use of Landing Craft Utility vessels for beach landings at some island locations, this activity is no longer proposed.

Following a June 2008 meeting, the USAF initiated informal consultations with the NMFS Pacific Islands Regional Office, as required by Section 7(a)(2) of the Endangered Species Act (ESA) (16 USC 1531-1544), because of potential effects on ESA-listed marine mammal species. In their response letter dated October 28, 2008 (see Appendix A, page A-7), the NMFS concluded that the two proposed HTV-2 flight tests are not likely to adversely affect ESA-listed species or their designated critical habitat. Findings on specific issues are detailed in the letter and are also discussed in Chapter 4.0 of this EA.

Also, in September 2008, Vandenberg AFB personnel wrote to the Permits, Conservation, and Education Division at NMFS Headquarters to confirm that no monitoring of pinnipeds on San Miguel Island of the northern Channel Islands would be needed during the HTV-2 launches. Under the marine mammal programmatic take permit issued to Vandenberg AFB (74 *Federal Register* [FR] 6236-6244), the base is required to monitor pinnipeds on the northern Channel Islands when launch-related sonic booms over the islands generate surface-level overpressures greater than 1 pound per square foot (psf). In an electronic mail response to Vandenberg AFB, dated November 6, 2008, the NMFS agreed that monitoring on San Miguel Island is not required (see Appendix A, page A-18). The monitoring of pinnipeds on Vandenberg AFB, however, is still required.

Although there are several Federally listed threatened and endangered species occurring at Vandenberg AFB that could be affected by the Proposed Action, base biologists concluded that reinitiation of formal consultations with the USFWS in Southern California was not needed because there are existing USFWS Biological Opinions in place and conditions at the HTV-2 launch site have not substantially changed. In

accordance with 50 CFR Part 402, no Biological Assessment is required and there is no further consultation obligation.

1.9 PUBLIC NOTIFICATION AND REVIEW

In accordance with the CEQ (2007) and USAF (2007a) regulations for implementing NEPA, the DARPA and the USAF solicited comments on the Draft EA from interested and affected parties. A Notice of Availability for the Draft EA, and the enclosed Draft FONSI, was published in local newspapers for both Vandenberg AFB and USAKA/RTS (see Table 1-1).

Table 1-1. Newspaper Publications for the Notice of Availability

Country or State	City/Town	Newspaper
California	Santa Barbara	*Santa Barbara News-Press*
	Santa Maria	*Lompoc Record*
		Santa Maria Times
Republic of the Marshall Islands	Majuro	*Marshall Islands Journal*
	USAKA/RTS	*Kwajalein Hourglass*

Copies of the Draft EA/Draft FONSI were placed at local libraries and were available over the Internet. A list of agencies, organizations, and libraries that were sent copies of the draft documents is provided in Chapter 8.0.

Following the 30-day public review period (as specified in the newspaper notices), comments received were considered in the preparation of the Final EA and the recommended changes were incorporated, as appropriate. Appendix F of this Final EA contains a reproduction of the written comments received, along with individual responses to each comment. A copy of the Final EA and the enclosed signed FONSI has been sent to those agencies, organizations, and individuals who provided comments on the Draft EA/Draft FONSI, or who specifically requested a copy of the final documents. The Final EA and signed FONSI are also available over the Internet at http://www.htv-2.com for a limited time.

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2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

Two actions are assessed in this EA: the Proposed Action and the No Action Alternative. Within this chapter, Section 2.1 provides a description of the Proposed Action, including the Minotaur IV Lite booster, the HTV-2 test vehicle, the launch site, flight scenarios, and terminal phase activities. Section 2.2 provides a description of the No Action Alternative. Alternatives to the Proposed Action that were considered and eliminated from further study are discussed in Section 2.3. A summary comparison of the environmental consequences associated with the Proposed Action and the No Action Alternative is presented in Section 2.4. Lastly, identification of the Preferred Action is presented in Section 2.5.

2.1 PROPOSED ACTION

2.1.1 FLIGHT VEHICLE DESCRIPTION

For each of the two HTV-2 flight test missions, the test vehicle payload would be launched from Vandenberg AFB into the upper atmosphere on a Minotaur IV Lite booster. Descriptions of both the booster and HTV-2 vehicle are presented in the sections that follow.

2.1.1.1 Minotaur IV Lite

The Minotaur IV Lite is a modified intercontinental ballistic missile (ICBM) that uses the first three Peacekeeper ICBM solid propellant stages. Unlike the full Minotaur IV vehicle, the “Lite” version does not have a fourth-stage rocket motor. Use of the Minotaur IV and other Peacekeeper-derived launch vehicles was previously analyzed in the *Final Environmental Assessment for the Orbital/Sub-Orbital Program* (USAF, 2006), hereafter referred to as the OSP EA. Analysis findings presented in the OSP EA identified no significant environmental effects from launching up to two Peacekeeper-derived vehicles per year from Vandenberg AFB.

The Minotaur IV Lite would consist of three main vehicle sections: a Government Furnished Equipment (GFE) 3-stage solid-propellant booster, Guidance and Control Assembly (GCA), and Payload Assembly. The overall vehicle length would be approximately 78 feet (ft) (23.8 meters [m]), with a maximum diameter of 7.7 ft (2.3 m) and a weight of approximately 195,000 pounds (lb) (88,400 kilograms [kg]), not including the mass of the HTV-2 payload. A diagram of the Minotaur IV Lite booster vehicle is provided in Figure 2-1.

Nearly the same as the Minotaur IV Lite, the now deactivated Peacekeeper ICBM has an extensive flight history with over 50 launches from Vandenberg AFB since 1983. The first-stage motor to be used on the Minotaur IV Lite is also the same as or equivalent to those previously used for Taurus missions launched from Vandenberg AFB and for the Athena Program, which conducted launches from Vandenberg AFB and other ranges.

Further discussions on key components of the Minotaur IV Lite are provided in the following sections.

2.1.1.1.1 Solid-Propellant Booster

The Minotaur IV Lite uses the Peacekeeper ICBM booster with three solid propellant rocket motor stages. Information on each motor’s dimensions, propellant weight, chemical components, and Department of

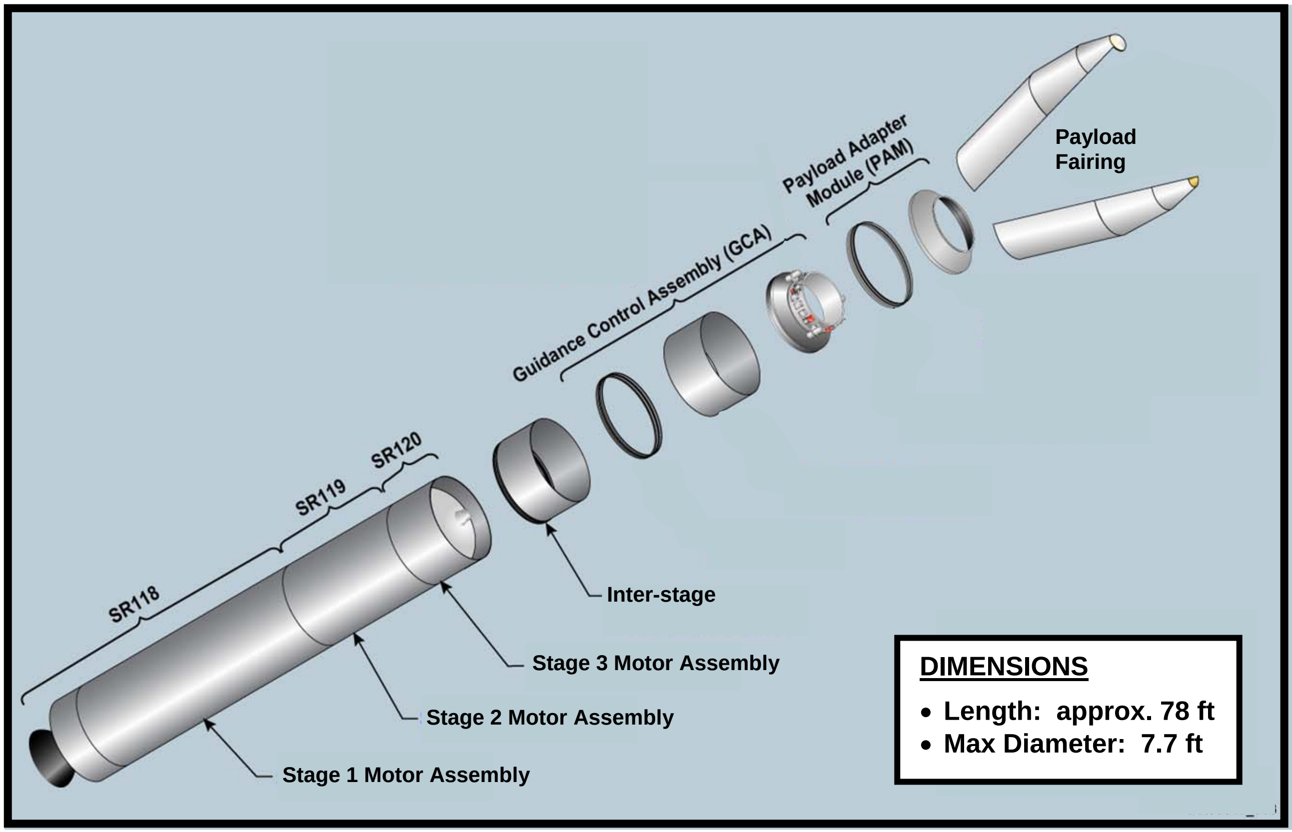


Figure 2-1. Minotaur IV Lite Vehicle

Defense (DOD)/US Department of Transportation (DOT) explosive classification is provided in Table 2-1. The motor casings are made primarily of KEVLAR® and carbon epoxy. The DOD explosive classification and division determines the method by which the rocket propellants and other ordnance are shipped and stored.[1] As shown in Table 2-1, the individual motors have a hazard classification/division of 1.3 or 1.1. When the motors are stored or stacked together (such as for launch), however, the combined explosives rating is 1.1. In accordance with DOD 6055.09-STD (*DOD Ammunition and Explosives Safety Standards*), this method of classification limits risks and decreases the chance of unintended catastrophic detonation.

During powered flight, each rocket motor uses a Thrust Vector Control (TVC) system (steering mechanism) for pitch and yaw control. The TVC system on all three rocket motors uses individual gas generators, with igniters, to power a hydraulically-actuated moveable nozzle that alters the thrust vector. Up to several gallons of hydraulic fluid are contained in each motor TVC system.

The base of the Stage-1 motor would be supported on a launch stool prior to launch. Inter-stages are used to connect some of the stages. A narrow raceway and cable system runs along the exterior of the stages and the inter-stages. Small amounts of ordnance, in the form of linear explosive assemblies, separate the

[1] US DOT regulations (49 CFR 173.56(b)(2)(i)) require the DOD to hazard classify items in accordance with Joint Technical Bulletin (TB) TB-700-2, *Department of Defense Ammunition and Explosives Hazard Classification Procedures.* TB-700-2 sets forth the detailed procedures for hazard classifying ammunition and explosives for transportation and storage in accordance with US DOT regulations, North Atlantic Treaty Organization guidelines, and United Nations recommendations.

Table 2-1. Solid-Propellant Rocket Motors for Minotaur IV Lite Vehicle						
Stage	Motor	Diameter ft (m)	Length ft (m)	Propellant		
				Quantity (approx.) lb (kg)	Main Components	DOD/DOT Classification
1st	SR-118	7.7 (2.3)	27.6 (8.4)	98,462 (44,662)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3 [1]
2nd	SR-119	7.7 (2.3)	19.7 (6.0)	54,138 (24,557)	Ammonium Perchlorate, Aluminum, Hydroxyl-Terminated Polybutadiene	1.3
3rd	SR-120	7.7 (2.3)	10.8 (3.3)	15,584 (7,069)	Ammonium Perchlorate, Aluminum, Cyclotetramethylene Tetranitramine, Nitroglycerine, Polyethylene Glycol	1.1 [2]

[1] A 1.3 hazard classification applies to materials with the potential for mass fire and minor blast or fragment.

[2] A 1.1 hazard classification applies to materials with the potential for mass explosion.

stages during flight. Other ordnance carried onboard would include motor igniter assemblies and an ordnance destruct package that initiates a thrust termination action if a launch anomaly occurs.

2.1.1.1.2 Guidance and Control Assembly

The GCA directs the course of the launch vehicle in flight. Components contained within this system include the flight computer, telemetry transmitter, telemetry multiplexer, dual flight termination receivers, radar transponder, batteries, and harnesses. Onboard transmitter (radio frequency) power output varies from 10 to 400 Watts (peak).

2.1.1.1.3 Payload Assembly

Located at the top of the launch vehicle, the Payload Assembly would encapsulate the HTV-2 test vehicle. The test vehicle attaches to the Payload Adapter Module (PAM) at the base of the assembly. A two-piece protective shroud, or fairing (composed of graphite/epoxy and aluminum), encloses and protects the payload prior to and during the vehicle's ascent after launch. The standard Payload Assembly measures approximately 20 ft (6.1 m) in length, with a maximum diameter of 7.7 ft (2.3 m). Maximum payload mass capability for the Minotaur IV Lite, including separation hardware, is approximately 3200 lb (1452 kg), depending on individual mission requirements.

During flight, a gas operated thruster system is activated to separate the fairing from the launch vehicle. Once the fairing is removed, payload separation from the PAM occurs.

2.1.1.1.4 Batteries

To provide electrical power for the Minotaur IV Lite, eight nickel-cadmium batteries are carried in the GCA. The battery weights range from 3 to 12 lb (1.4 to 5.4 kg) each. Two batteries are for command destruct systems, two are for ordnance, and the remainder are for avionics power.

2.1.1.2 Hypersonic Technology Vehicle 2

The HTV-2 vehicle represents a test bed to demonstrate hypersonic flight in the upper atmosphere. The vehicle would be designed to fit inside of the Minotaur IV Lite Payload Assembly (fairing), and its mass at launch would be well within the payload capability of the Minotaur IV Lite booster (see Section 2.1.1.1.3). Figure 2-2 shows the basic shape of the HTV-2 vehicle, and Table 2-2 lists the vehicle's key system characteristics.

Figure 2-2. Hypersonic Technology Vehicle 2

Table 2-2. HTV-2 System Characteristics	
Structure	Aluminum, titanium, steel, tantalum, tungsten, carbon fabric, silica, and other alloys that include approximately 0.35 ounces (10 grams) of beryllium, 4.0 lb (1.8 kg) of chromium, and 10.3 lb (4.7 kg) of nickel
Communications	Various 5 to 20 Watt (radio frequency) transmitters; maximum 900 Watt radio frequency pulse
Power	Up to four lithium ion and lithium thionyl chloride batteries, each weighing between 1 and 40 lb (0.5 and 18.5 kg)
Propulsion	Approximately 3 lb (1.4 kg) of pressurized nitrogen gas
Other	Ten small Class C (1.4) electro-explosive devices for mechanical systems operation

Per Table 2-2, hazardous materials used in the HTV-2 vehicle would consist of small quantities of toxic metals, batteries, and small explosive devices. No solid or liquid propellants, radioactive materials, or other ordnance would be carried in the vehicle. Each battery would be fully environmentally qualified, including safeguards for containing accidental hazardous battery casing leakage, or electrical anode/cathode shorting that could result in overheating and explosion. The nitrogen gas cylinders would have adequate safety factors for proof and burst pressures in accordance with MIL-STD-1411A

(*Inspection and Maintenance of Compressed Gas Cylinders*). All small explosive devices would be handled in accordance with DOD 6055.09-STD to avoid accidental activation and limit risks of injury to humans and the environment.

2.1.2 DEMONSTRATION FLIGHT TESTS

The DARPA and the USAF propose to conduct two HTV-2 demonstration flight tests, referred to as Missions A and B. This section describes: (1) the launch preparations and operations to occur at Vandenberg AFB; (2) the HTV-2 flight scenarios over the Pacific Ocean; and (3) the terminal phase preparations and operations to occur at or near USAKA/RTS.

2.1.2.1 Launch Site Preparations and Operations

Vandenberg AFB is the headquarters of the 30th Space Wing, which conducts space and missile test launches, and operates the Western Range.[2] The base hosts a variety of Federal agencies and commercial aerospace companies and activities, including the Spaceport Systems International (SSI) Commercial Spaceport.

In support of the HTV-2 flight tests at Vandenberg, a combination of USAF and commercially operated facilities would be used, including the SSI Commercial Launch Facility (referred to as Space Launch Complex [SLC] 8). The facilities that would be used in support of HTV-2 are listed in Table 2-3 and shown on Figure 2-3. Most of these facilities were previously analyzed in the OSP EA for Minotaur IV and other Peacekeeper-derived missions (USAF, 2006).

Table 2-3. List of Facilities Proposed to Support the HTV-2 at Vandenberg AFB, CA

Facility / Building	Planned Function	Site Modifications and Construction
Launch Facilities		
SSI Commercial Launch Facility, (Space Launch Complex [SLC] 8) (Building 240) [1]	Launch Site	None
Other Support Facilities		
SSI Integrated Processing Facility (IPF) (Building 375) [1]	Launch Control	None
Remote Launch Control Center (Building 8510)	Alternate Launch Control	None
Astrotech Payload Processing Facility (PPF) (Building 1032)	Payload Processing	None
Integration Refurbishment Facility (IRF) (Building 1900)	Booster Processing	Minor building modifications
Rail Transfer Facility (Facility 1886)	Motor Transfer	None

[1] Commercial building/facility licensed by the Federal Aviation Administration/Office of Commercial Space Transportation.

[2] The Western Range extends from the CA Coast to the Indian Ocean and consists of a vast array of space and missile tracking and data gathering equipment. Up-range instrumentation sites are located on Vandenberg AFB, Pillar Point Air Force Station, Anderson Peak, and Santa Ynez Peak. Midrange instrumentation is located on the Hawaiian Islands. Western Range instrumentation is supplemented by Point Mugu Naval Air Warfare Center in CA, the USAKA/RTS, and US Air Force Maui Optical Site in Hawaii.

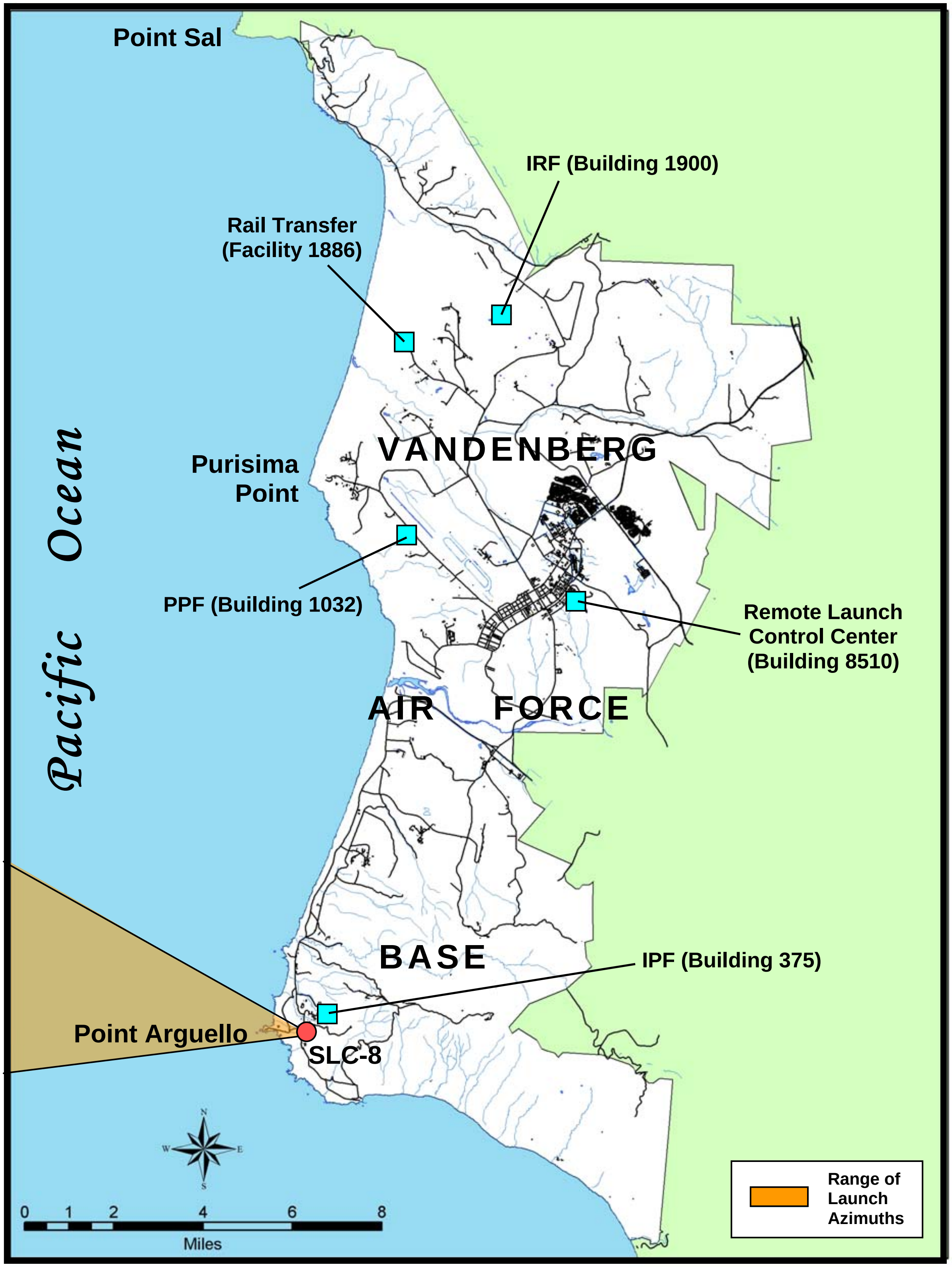


Figure 2-3. Facilities Proposed to Support the HTV-2 at Vandenberg AFB, CA

SSI currently operates the spaceport facility under a launch site operator license that was renewed by the Federal Aviation Administration (FAA)/Office of Commercial Space Transportation (AST) in September 2006. A launch site operator license remains in effect for 5 years from the date of issuance, unless surrendered, suspended, or revoked before the expiration of the term, and is renewable upon application by the licensee (14 CFR 420.43). A license to operate a launch site authorizes a licensee to offer its launch site to a launch operator (such as the DARPA and USAF) for each launch point for the type and weight class of vehicle identified in the license application and upon which the licensing determination is based. The launch site operator license authorizes SSI to conduct Government and licensed launches of orbital expendable vehicles within the small payload weight class (less than or equal to 3,300 lb [1,497 kg]).

2.1.2.1.1 Site Modifications

For the SLC-8 launch site, no facility modifications are planned for the two HTV-2 missions. Minor modifications to the IRF would include installation of lightning protection, adding fall protection to the roof, and changing the ordnance grounding points. No other buildings or facilities at Vandenberg AFB would require modifications or construction to support the HTV-2 missions.

2.1.2.1.2 Rocket Motor Transportation

For each HTV-2 mission, the three rocket motor stages (SR-118, SR-119, and SR-120) would be removed from storage, and inspected and tested for flight worthiness at Hill AFB, Utah, prior to shipment to Vandenberg AFB.

Each stage would be individually shipped to Vandenberg AFB from Hill AFB by truck and/or rail using specialized equipment to handle the heavy motors. The 1st-stage SR-118 motor, which weighs in excess of 100,000 lb (45,360 kg), would be shipped to the base by rail (whenever possible) and offloaded at the IRF (Building 1900) using overhead cranes, or offloaded at the Rail Transfer Facility (Facility 1886) using mobile cranes. For over-the-road transportation, a multi-axle, heavy haul commercial trailer would be used. This type of semi-trailer has several steerable axles and a suspension system that provides road shock isolation and leveling capability. A Type II semi-trailer and tractor with eight axles could be used for the smaller and lighter-weight 2nd- and 3rd-stage motors (SR-119 and SR-120, respectively).

All transportation, handling, and storage of the rocket motors and other ordnance would occur in accordance with DOD, USAF, and US DOT policies and regulations to safeguard the materials from fire or other mishap. This process would include obtaining oversize/overweight-hauling permits, as necessary, from each state through which transportation would occur. The USAF transports rocket motors from Hill AFB to Vandenberg AFB several times a year as a routine operation. The US Military Surface Deployment and Distribution Command would be responsible for all Minotaur IV rocket motor transfer operations.

To support implementation of Minotaur IV and other Peacekeeper-derived missions, the USAF prepared a detailed transportation plan for moving Peacekeeper rocket motors to Vandenberg AFB (Northrop Grumman, 2005). This plan addresses the shipping and handling of the motors, as well as applicable regulatory requirements.

2.1.2.1.3 Pre-Launch Preparations

Once the rocket motors arrive at Vandenberg AFB, personnel would inspect them before taking them to either an existing bunker for temporary storage or to the IRF (Building 1900) to initiate booster integration and systems testing. During motor/booster processing, contractors would add a destruct

package with small quantities of ordnance. The purpose of the destruct package is to terminate motor thrust if unsafe conditions develop during powered flight.

The HTV-2 test vehicle would arrive at Vandenberg AFB via truck or aircraft and be transported to the Astrotech PPF (Building 1032). At the Astrotech PPF, contractors would conduct final vehicle assembly and various system/subsystem tests. These actions would include attaching the vehicle to the PAM and encapsulating it in the Payload Fairing to form the Payload Assembly.

Following booster processing and integration tests, the motors would be transported individually to SLC-8, where a mobile crane would stack them on the launch stand one at a time. The Payload Assembly containing the HTV-2 test vehicle would be transported separately to the launch site and installed on the completed booster stack last. Prior to transporting the Payload Assembly, personnel would conduct a route survey from the Astrotech PPF to SLC-8 to ensure road surfaces and overhead wire clearances are adequate. At SLC-8, the mobile access tower would provide worker access to each stage of the launch vehicle.

In addition to the propellants, ordnance, and batteries used in the flight test vehicle, processing and integration activities for the booster and HTV-2 would require the use of small quantities of lubricants, paints, sealants, and solvents (less than 10 lb [4.5 kg] per flight test vehicle). All use of hazardous materials would comply with applicable Vandenberg AFB hazardous materials management requirements.

Electrical power for operations would come from existing commercial power. A portable diesel generator would be available at SLC-8 for emergency power only. The generator would be provided by the launch contractor and permitted by the Santa Barbara County Air Pollution Control District (SBCAPCD) or registered under the California Air Resources Board's (CARB) Portable Equipment Registration Program.

2.1.2.1.4 Launch Activities

On the day of launch, final vehicle closeout and appropriate arming operations are performed. At SLC-8, the mobile access tower is retracted in preparation for countdown and launch. Both missions would be launched on a predetermined azimuth ranging from 260 to 300 degrees (see Figure 2-3). Launch operations would be conducted from either the SLC-8 Launch Control Room, which is located on the hardened side of the SSI IPF, or from Building 8510.

Prior to conducting each launch, USAF personnel would conduct a comprehensive safety analysis to determine specific launch and flight hazards. A standard dispersion computer model, run by installation safety personnel, would be used for both normal and aborted launch scenarios. As part of this analysis, risks to off-base areas and non-participating aircraft, sea vessels, and personnel are determined. The results of this analysis are then used to identify the launch hazard area, expended booster drop zones, and a terminal hazard area for shroud components. A flight termination boundary along the vehicle flight path is also predetermined in case a launch vehicle malfunction or flight termination action occurs. The flight termination boundary defines the limits at which command flight termination would be initiated to contain the vehicle and its debris within predetermined hazard and warning areas, thus minimizing the risk to test support personnel and the public.

As a normal procedure, commercial and private aircraft, and watercraft, are notified of all the hazard areas several days prior to launch through a Notice to Airmen (NOTAM) and Notice to Mariners (NOTMAR). Within a day prior to each launch, radar and other remote sensors are used to verify that the hazard areas are clear of non-mission-essential aircraft, vessels, and personnel. Recreational areas in the

vicinity of the base may be closed for some launches—typically for less than a day—depending on the launch trajectory. Commercial train movements through the base are also coordinated and monitored.

The USAF also notifies oilrig companies of an upcoming launch event several days in advance. The notification requests that oilrigs temporarily suspend operations and evacuate or shelter their personnel if rigs are located in the path of the launch vehicle overflight.

If a launch vehicle heads off course or should other problems occur during flight, then the Missile Flight Control Officer would activate the destruct package on the vehicle. The signal to destruct is initiated by receipt of a radio command from the base. The destruct package also contains the logic to detect a premature separation of the booster stages and initiate a thrust termination action on its own. Thrust is terminated by initiation of an explosive charge that splits or vents the motor casing, which releases pressure and significantly reduces propellant combustion. This action would stop the vehicle's forward thrust, causing the vehicle to fall along a ballistic trajectory into the ocean. Other explosive charges located near the Payload Assembly would disable the HTV-2 vehicle's ability to fly in case it separated from the booster prematurely.

2.1.2.1.5 Post-Launch Operations

The pad area would be checked for safe access after vehicle liftoff from the launch pad. Post-launch activities would include inspection of the launch pad facilities, launch platform, and equipment for damage, as well as general cleanup and performance of maintenance and repairs necessary to accommodate the next launch cycle. The expended rocket motors and other vehicle hardware would not be recovered from the ocean following flight.

2.1.2.2 Flight Scenarios

Following motor ignition and liftoff from Vandenberg AFB, the Minotaur IV Lite 1st-stage motor would burn out and separate from the 2nd stage. Further into flight, the 2nd-stage and 3rd-stage motors would also burn out and separate. Splashdown of all three spent motor stages would occur at different points in the open ocean between 100 and 2,000 nmi (185 and 3,704 km) off the CA coast. Figure 2-4 shows representative flight paths and rocket drop zones for both HTV-2 missions launched from Vandenberg AFB towards USAKA/RTS in the Marshall Islands.

Jettison of the fairing and HTV-2 vehicle separation would occur outside the atmosphere at an altitude of several hundred thousand feet. Following separation, the HTV-2 vehicle would use autonomous flight control to maneuver and begin the hypersonic glide portion of the test flight between 150,000 and 250,000 ft (45,720 and 76,200 m) in altitude. Flight paths for both Missions A and B would extend well north of the Hawaiian Islands, with only Mission A flying over a portion of the Northwestern Hawaiian Islands (NWHI). Mission B, however, may include overflight of Wake Island located in the mid-Pacific. As each HTV-2 vehicle nears USAKA/RTS (the terminal end of the flight) at an altitude of about 100,000 ft (30,480 m), it would maneuver towards the pre-designated ocean impact area.

During HTV-2 flight, if a malfunction occurs, onboard systems would prevent active steering control, causing the vehicle to roll into a ballistic spiral (corkscrew-like flight pattern) towards the ocean and terminate flight. No inhabited land areas would be subject to unacceptable risks of falling debris. Computer-monitored destruct lines, based on no-impact lines, are pre-programmed for the Flight Safety software to avoid any debris falling on inhabited areas, as per Space System Software Safety Engineering protocols and US range operation standards and practices. In accordance with US range operation

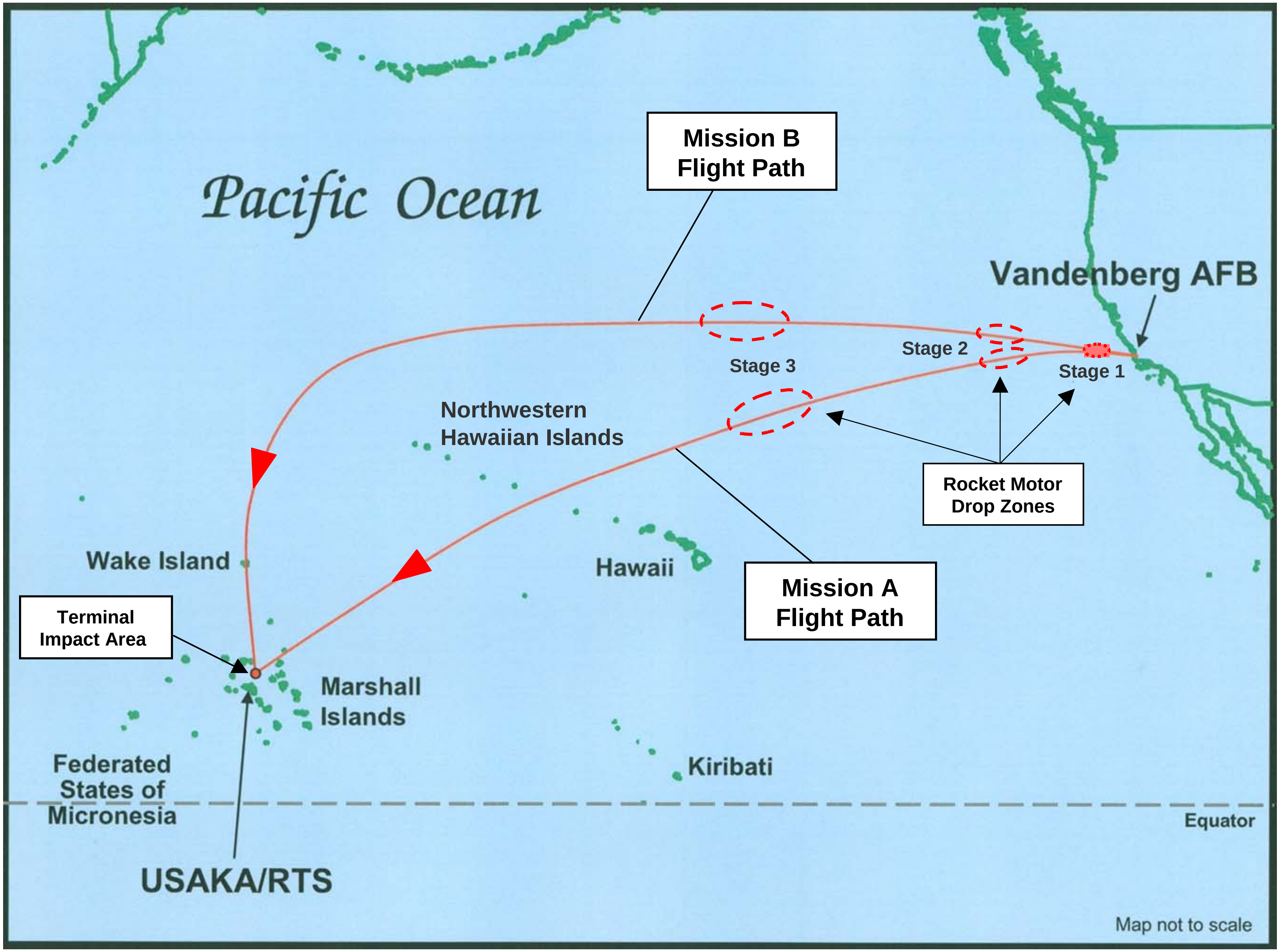


Figure 2-4. Representative HTV-2 Over-Ocean Flight Paths

standards, the risk of casualty (probability for serious injury or death) from falling debris for an individual of the general public cannot exceed 1 in 1,000,000 during a single flight test or mission (Range Commanders Council [RCC], 2007).

2.1.2.3 Terminal Phase Preparations and Operations

For more than 16 years, the USAKA/RTS has been a target area for hypersonic vehicle impacts from ICBM flight tests launched from Vandenberg AFB. Such impacts have occurred within the Kwajalein Atoll lagoon, in the vicinity of Illeginni Island, and in the BOA near USAKA/RTS. These actions were previously analyzed in the following environmental documents:

- *Final Environmental Assessment for Minuteman III Modification* (USAF, 2004), hereafter referred to as the Minuteman-III EA
- *Final Supplemental Environmental Impact Statement for Proposed Actions at US Army Kwajalein Atoll* (US Army Space and Strategic Defense Command [USASSDC], 1993)
- *Environmental Assessment for Department of Energy (DOE) Reentry Vehicles, Flight Test Program, US Army Kwajalein Atoll, Republic of the Marshall Islands* (USAF, 1992).

Like many of the ICBM hypersonic vehicle tests, the proposed HTV-2 flight tests would use the BOA near USAKA/RTS for deep-water impacts. Figure 2-5 shows representative flight paths for both Missions A and B, with terminal impact occurring in international waters approximately 40 to 80 nmi (74 to 148 km) north of Roi-Namur Island.

2.1.2.3.1 Pre-Test Preparations and Support

The USAKA/RTS has an extensive array of missile tracking radars and sensors located on several of the Kwajalein Atoll islands. For the two HTV-2 flight tests, the range would provide telemetry, tracking, sensing, and other technical and logistical support. In addition to the fixed assets at USAKA/RTS, several mobile assets listed in Table 2-4 might also be used to support the flight tests. Existing personnel based at USAKA/RTS would provide most of the test support at the range and within the BOA, including vessel and sensor operations. Depending on mission requirements, other auxiliary land-based, sea-based, and/or aircraft-based sensors may be involved in tracking the HTV-2 vehicles and collecting data at various locations along the over-ocean flight corridors. These existing systems would be operated in their normal capacity in support of the HTV-2 missions and/or they would monitor the missions as targets of opportunity.

As described in Table 2-4, free-floating rafts with onboard optical and/or acoustical sensors and telemetry equipment (see Figure 2-6) may be placed in the vicinity of the BOA impact area, in international waters, within a day of each test. One or two existing LCU vessels based at USAKA—the US Army Double Eagle and/or the US Army Great Bridge (see Figure 2-7)—would be used to deploy all or most of the rafts. Battery-powered sensors and telemetry equipment on the rafts would collect data during the vehicle’s descent until impact.

Other sensors mounted on vessels would also collect data. Sensors on the US Army Vessel (USAV) Worthy (Figure 2-8) may be used to track and collect telemetry data from the end of the HTV-2 glide through to impact. Other tracking sensors may be mounted on one of the LCUs or another large vessel. Within hours of each test, the vessels would be positioned in the vicinity of the BOA to track and record the HTV-2 final flight and descent.

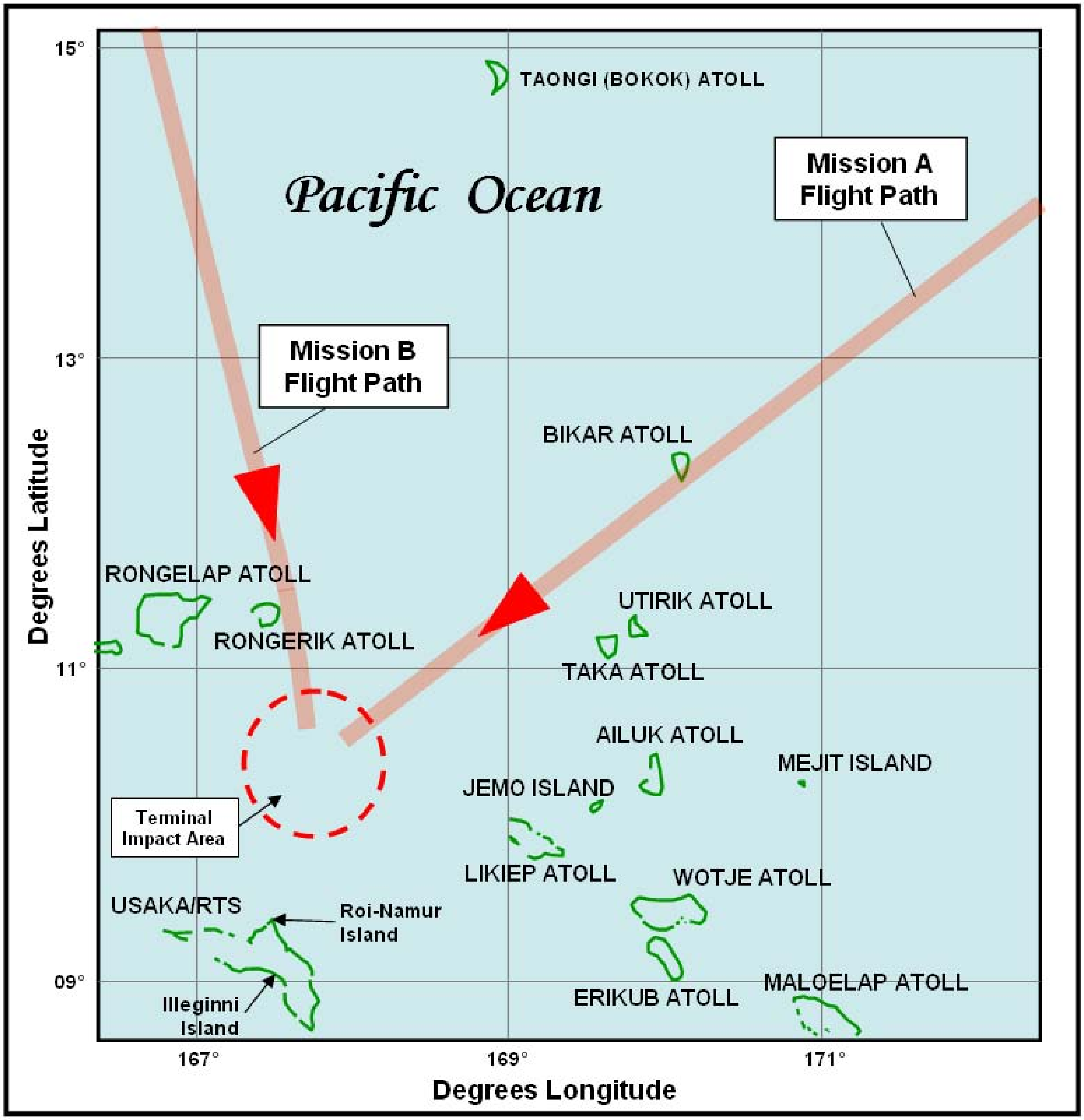
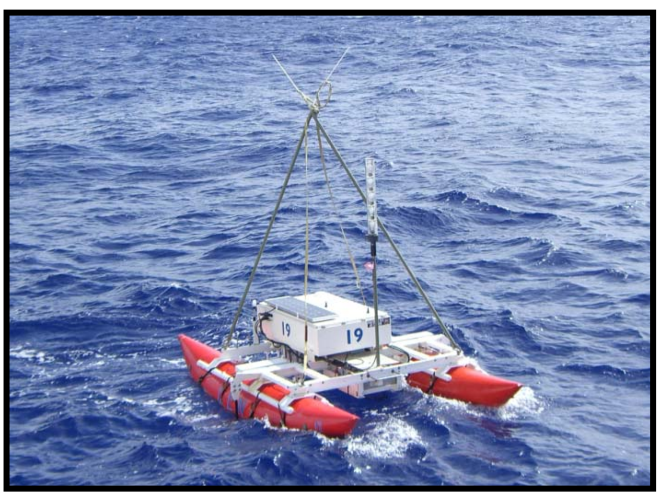


Figure 2-5. Representative HTV-2 Flight Paths near USAKA/RTS in the Marshall Islands

Table 2-4. Potential Mobile Assets to be used near USAKA/RTS in the Marshall Islands

Test Asset	Description	Support to HTV-2
Vessels		
US Army Double Eagle	Landing Craft Utility (LCU) used for intra-atoll and BOA support, based at USAKA, 117 ft (35.7 m) long and 390 short tons (354 metric tons).	Used to deploy free-floating sensors in the BOA and potentially provide sea-based sensor support.
US Army Great Bridge	LCU used for intra-atoll and BOA support, based at USAKA, 174 ft (53.0 m) long and 1,102 short tons (1,000 metric tons) loaded.	Used to deploy free-floating sensors in the BOA and potentially provide sea-based sensor support.
USAV Worthy	T-AGOS class ship commissioned to serve as a mobile instrumentation platform, based at USAKA/RTS, 224 ft (68.3 m) long and 1,565 short tons (1,419 metric tons).	While positioned in the vicinity of the BOA impact area, onboard sensors would track the HTV-2 in flight and collect telemetry and other data.
Other surface ship or large vessel	Similar in size and class to the US Army Great Bridge or USAV Worthy.	While positioned in the vicinity of the BOA impact area, onboard sensors would track the HTV-2 in flight and collect telemetry and other data.
Sea-Based Sensors (free-floating)		
Raft Scoring System (RSS)	Up to 16 rafts equipped with onboard sensors. Battery-powered electric motors provide propulsion to maintain position in water.	Deployed from vessels in the BOA. Used for recording terminal flight and determining impact location of the HTV-2.
Other raft systems	Up to three rafts equipped with telemetry equipment. Battery-powered electric motors provide propulsion to maintain position in water.	Deployed from vessels in the BOA. Used to collect telemetry data from the HTV-2 during terminal flight.
Land-Based Sensors		
S-band Transportable Ground System (STGS) or a similar system	A mobile, land-based telemetry system using a 12 ft (3.7 m) parabolic antenna. Other auxiliary/support equipment includes a small satellite communications terminal with a 6 ft (1.8 m) parabolic antenna, two portable generators, tent/shelter, and an air conditioning unit. All equipment is man-portable.	Deployed onto an island in the vicinity of the glide path from a vessel or from an aircraft. Used to collect and record real-time telemetry data during the HTV-2 flight.



Source: Yakuma, 2008

Figure 2-6. Representative Sensor Raft System

Source: Office of the Chief of Transportation, 2007 (Images are representative of each named vessel.)

Figure 2-7. US Army Landing Craft Utility Vessels

Source: Drumheller, 2007

Figure 2-8. US Army Vessel Worthy

Whales or other marine mammals may occasionally swim within the vicinity of the BOA impact area. If ship personnel observe marine mammals during deployment of free-floating sensors, they would report such sightings to the USAKA Environmental Management Office, the RTS Range Directorate, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list for consideration in approving the launch. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of marine mammals.

HTV-2 test plans might also include use of one STGS or a similar system to be located on Wake Island in support of Mission B (see Figure 2-4). The STGS is a man-portable telemetry system that uses a 12 ft (3.7 m) parabolic antenna (Figure 2-9).

Figure 2-9. S-band Transportable Ground System Antenna

To transport the STGS and other auxiliary/support equipment to Wake Island, normally scheduled USAF flights to the island would likely be used. A crew of two or three personnel would temporarily set up and operate the STGS. System setup would require a generally flat location at least 1,000 square ft (93 square m) in area that is paved or has little or no vegetation. This area would include space to set up and operate a small satellite communications terminal, a tent/shelter, and two portable generators. No vegetation clearing, grading, or excavation is planned for system deployment at Wake Island. STGS deployment would be expected to last no more than a week.

Wake Island is an unorganized, unincorporated territory of the US administered by the US Department of the Interior. Access to the island is restricted and all current activities on the island are managed by the USAF and a base operations and maintenance contractor (Missile Defense Agency [MDA], 2007b). Proposed deployment and operation of the STGS at Wake Island would occur in a similar manner to that of other portable telemetry and sensor systems previously analyzed for Wake Island and other locations, as described in the following environmental documents:

- *Wake Island Supplemental Environmental Assessment* (MDA, 2007b)
- *Mobile Sensors Environmental Assessment* (MDA, 2005)
- *Wake Island Launch Center Supplemental Environmental Assessment* (MDA, 1999)
- *Final Environmental Assessment for Rapid Attack Identification, Detection, and Reporting System—Block 10* (USAF, 2007b).

Because the use of similar sensor systems at Wake Island identified no significant impacts to the human or natural environments, the proposed deployment and operation of the STGS at Wake Island is not analyzed further in this EA.

2.1.2.3.2 *Terminal Flight and Impact Activities*

To ensure the safe conduct of these types of flight tests, the USAKA/RTS would implement standard range safety procedures. Just as at Vandenberg AFB, NOTAMs and NOTMARs would be published and circulated in accordance with established procedures to warn personnel and inhabitants of the RMI of potential hazard areas they should avoid. Radar sweeps of the hazard areas would be conducted immediately prior to the flight tests to ensure that non-mission ships and aircraft are clear. Personnel on the HTV-2 mission-support vessels would also conduct visual surveys to help confirm that the test area is clear.

2.1.2.3.3 *Post-Test Operations*

The HTV-2 vehicles are expected to breakup on impact in the BOA. Because debris resulting from impact would consist primarily of metal components, little or no floating debris is expected. Vehicle components would sink thousands of feet to the ocean floor.

Following impact, post-test operations would include the recovery of all free-floating raft sensors using the LCUs or other vessels. If during recovery operations, HTV-2 debris was found floating in the water, then it would be collected for proper disposal in accordance with USAKA/RTS policies and procedures. If ship personnel were to identify any injured or dead marine mammals or sea turtles during recovery operations, then the personnel would report the information to the USAKA Environmental Management Office, which would then inform the NMFS in Honolulu. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of dead or injured mammals. Following all recovery operations, the LCUs and the USAV Worthy would return to their homeport at USAKA/RTS.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the two HTV-2 flight tests proposed to occur at Vandenberg AFB and at USAKA/RTS would not be conducted. By not implementing the Proposed Action, the DARPA and the USAF would not be able to achieve the goal of demonstrating hypersonic technologies for future capabilities in support of our nation’s defense. Laboratory testing of subsystems and hardware may continue; however, HTV system development would be slowed or postponed.

2.3 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Although computer simulations, modeling, and other laboratory tests are typically used during the design and early evaluation of flight test vehicles, such methods cannot provide all of the information needed to satisfy mission requirements (e.g., verify system operation and performance). Alternatives that relied solely on such methods would not satisfy the purpose and need and, thus, were eliminated from further consideration.

The two HTV-2 flight tests would require a combination of launch and impact sites that could provide the flight distance, facilities, and instrumentation needed to meet HTV-2 mission objectives. Because of its wide array of sensors and applicable ICBM test program experience, the USAKA/RTS was the only range considered for conducting the HTV-2 impacts. The DARPA and the USAF had first considered using Illeginni Island at USAKA/RTS for land impacts, similar to the hypersonic vehicle impacts conducted as part of the ongoing ICBM flight tests (USAF, 1992, 2004). USAF range safety personnel later determined, however, that such tests were deemed unreasonable because the proposed HTV-2 flight tests

could not fully satisfy all of the standard range safety requirements. Thus, the HTV-2 impacts could only occur within the BOA near USAKA/RTS.

For temporary deployment of the STGS or a similar land-based telemetry system, the DARPA and the USAF considered other island/atoll locations in the Marshall Islands including Rongelap, Taka, Taongi, and Utirik Atolls (see Figure 2-5). The DARPA, however, decided to drop all of these locations from further considerations because of limited transportation access at the atolls and the presence of sensitive biological resources (e.g., migratory birds and sea turtle nesting sites) at most of the locations. The flight test missions would satisfy telemetry requirements by using Wake Island for land-based telemetry and other mobile telemetry assets.

As for the Minotaur IV Lite launch site, the DARPA and the USAF considered Vandenberg AFB; Kodiak Launch Complex, Alaska; and the Pacific Missile Range Facility, Hawaii. The Kodiak Launch Complex and Pacific Missile Range Facility, however, did not provide a long enough flight distance to fully meet mission objectives. As a result, Vandenberg AFB was selected as the launch site. For conducting the Minotaur IV Lite launches from Vandenberg AFB, the DARPA and the USAF considered other alternative launch pads in addition to SLC-8. The other launch pads, however, would have required excessive construction and renovations at a higher cost and with potential for greater environmental effects (e.g., Test Pad 01, Advanced Ballistic Reentry System [ABRES] A, and ABRES B). Use of SLC-8 for Minotaur IV Lite launches was previously analyzed in the OSP EA, which identified no significant environmental effects from such launches.

2.4 COMPARISON OF ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

Table 2-5 presents a comparison of the potential environmental consequences of the Proposed Action and the No Action Alternative for those locations and resources affected. Only those resource areas potentially affected are addressed (see Chapter 3.0 for a rationale of resources analyzed). A detailed discussion of the potential effects is presented in Chapter 4.0 of this EA.

2.5 IDENTIFICATION OF THE PREFERRED ACTION

The DARPA and the USAF Preferred Action is to implement the Proposed Action at Vandenberg AFB and at USAKA/RTS, as described in Section 2.1 of this EA.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
Vandenberg Air Force Base, CA		
Air Quality	The HTV-2 program launches represent short-term, discrete events. In boost flight, the rocket emissions from each stage would be rapidly dispersed over a large geographic area and by prevailing winds. The total direct and indirect emissions associated with the Proposed Action at Vandenberg AFB were estimated to include release of 0.31 tons (0.28 metric tons) of volatile organic compounds (VOC) and 12.3 tons (11.2 metric tons) of total particulate matter. Emission levels would not exceed *de minimis* (minimal importance) thresholds, be regionally significant, or contribute to a violation of Vandenberg AFB's air operating permits. No exceedance of air quality standards or health-based standards for non-criteria pollutants would be anticipated.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts to air quality would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.1 of the EA.
Noise	Noise from site modifications and pre-launch preparations would be short-term and local. Although HTV-2 program launches would generate noise levels well above 100 decibels (dB) A-weighted Sound Exposure Level (ASEL) near the launch site, noise levels within the City of Lompoc and in other communities off base would be well below 85 dB. Launch noise would be infrequent (only two launches are planned), very short in duration (about 20 seconds of intense sound per launch), and have little effect on the Community Noise Equivalent Level (CNEL) for these areas. Because flight trajectories would be in a westerly direction, sonic booms would not be audible on any coastal areas, including the northern Channel Islands.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts to the noise environment would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.2 of the EA.
Biological Resources	Rocket launch emissions and ground-level heat from the rocket plume are expected to have minimal effects on nearby vegetation, wildlife, and surface water habitats. Exposure to short-term noise from launches and helicopter overflights (if conducted) could cause startle effects in protected bird species, pinnipeds, and other wildlife. However, on the basis of prior monitoring studies conducted on base, biologists have determined that rocket launch activities have negligible, short-term impacts on marine mammals, most sea and shore birds, and other protected species. Programmatic take permit limits for pinnipeds would not be exceeded, and both acoustic and biological monitoring would be conducted, as necessary.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts to biological resources would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.3 of the EA.
Cultural Resources	For the HTV-2 program, there are no plans for excavations or other ground disturbance that could affect archaeological sites. Two facilities proposed for HTV-2 program use are eligible for listing on the National Register of Historic Places (NRHP) because of their Cold War historic context. Modifications are proposed for only one of the buildings (Building 1900); however, the modifications are considered routine upgrades that are allowable under an existing Programmatic Agreement between Vandenberg AFB and the California State Historic Preservation Officer (SHPO). In addition, the building has been documented to Historic American Engineering Record (HAER) standards as partial mitigation for impacts related to another launch program (beddown of the Ground-Based Midcourse Defense [GMD] system). The existing HAER, and reuse of the building for HTV-2 activities that are similar to its original Peacekeeper mission, would further mitigate any impacts from the proposed modifications. No impacts to archaeological sites or historic structures are expected from nominal flight activities.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts to cultural resources would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.4 of the EA.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
Health and Safety	The launch vehicle integration and flight tests represent routine types of activities at Vandenberg AFB. Allowable public risk limits for launch-related debris would be extremely low; individuals within the general public would not be exposed to a probability of casualty greater than 1 in 1,000,000 for a single mission. Accident rates for ongoing operations involving solid rocket motor transportation over public roads are historically very low (e.g., 0.000002 accidents per mile [mi] driven). By adhering to established and proven safety standards and procedures, the level of risk to all personnel would be minimal.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts to health and safety would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.5 of the EA.
Hazardous Materials and Waste Management	Mission support personnel would manage all hazardous materials in accordance with well-established policies and procedures. Hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling requirements would not exceed current capacities and management programs would not have to change.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on hazardous materials and waste management would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.1.6 of the EA.
Over-Ocean Flight Corridor and the Global Environment		
Global Atmosphere	The two HTV-2 flight tests would release approximately 33 tons (30 metric tons) of hydrogen chloride (HCl) and 0.27 tons (24 metric tons) of free chlorine (Cl) into the atmosphere. However, solid rocket motors make a relatively small contribution to global ozone losses compared to other sources. It is estimated that the emission loads of chlorine (as HCl and Cl) from rocket launches worldwide, as projected from 2004 to 2014, would account for only 0.5 percent of the industrial Cl load from the US over the 10-year period. The greenhouse gas (GHG) emissions from all combined HTV-2 activities at Vandenberg AFB and from both launches would release approximately 304 tons (276 metric tons) of carbon dioxide (CO_2). This amount of CO_2 represents less than 0.0001 percent of the anthropogenic emissions for this gas released on a global scale annually. As a result, the HTV-2 flight tests would not contribute significantly to ozone layer depletion or to global warming.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on the stratospheric ozone layer and on global warming would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.2.1 of the EA.
Biological Resources	The underwater propagation of sonic booms produced by the Minotaur IV Lite booster during launch is not expected to exceed 7.2 psf (a conservative estimate based on the Atlas V booster), which is equivalent to 171 dB (referenced to 1 microPascal [re 1 μPa]) in water. Following HTV-2 separation from the booster, as the test vehicle begins to hypersonic glide towards USAKA/RTS, it also would generate a moving sonic boom or carpet boom with a maximum peak overpressure of 0.21 psf (equivalent to 140 dB [re 1 μPa] in water). The HTV-2 vehicle carpet booms over the NWHI and Wake Island also would be minimal in strength (about 111 dB [re 20 μPa] in air and 137 dB [ref to 1 µPa] underwater), resulting in minimal impacts to migratory birds, seals, and other species at these island locations. Following launch of the Minotaur IV Lite booster, spent rocket motors could strike marine life in the open ocean, and the resulting underwater shock/sound wave could cause auditory effects, other injuries, or death to protected marine mammals and sea turtles. Because of the limited ocean areas	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on biological resources would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.2.2 of the EA.

Table 2-5. Comparison of Potential Environmental Consequences		
Locations and Resources Affected	**Proposed Action**	**No Action Alternative**
	affected and the low density of protected species, the potential risk to animals is negligible. Seawater would rapidly dilute hazardous materials released from the spent motors, and components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life.	
US Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site and the Marshall Islands		
Noise	The resulting HTV-2 sonic booms (carpet booms) over Rongelap and Utirik Atolls would affect the local RMI communities, but only once within each community. The carpet boom overpressures are expected to be around 0.12 psf (109 dB [re 20 μPa] in air), less than the 120 dB produced by a thunderclap at close range and well within the US Occupational Safety and Health Administration (OSHA) standard of 140 dB (peak sound pressure level) for impulse noise. The focused sonic boom over the BOA, just before HTV-2 vehicle impact, would only occur twice (once for each flight test) and would not affect any RMI communities or other land areas.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on noise would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.3.1 of the EA.
Biological Resources	Deployment of vessels and free-floating sensors in the BOA would have little or no impact on marine mammals and sea turtles. The HTV-2 vehicle carpet booms would occur only once at each location, resulting in a maximum peak overpressure of 0.21 psf (equivalent to 114 dB [re 20 μPa] in air and 140 dB [re 1 μPa] in water). Such noise levels would have minimal impacts on terrestrial and marine species. During terminal flight, the HTV-2 would generate a focused boom in the BOA that would result in higher underwater sound levels ranging from about 129 to 182 dB (re 1 μPa). The HTV-2 ocean impact could also strike marine life in the open ocean, and the resulting underwater shock/sound wave could cause auditory effects, other injuries, or death to protected marine mammals and sea turtles. Because of the limited ocean areas affected and the low density of protected species in the BOA, the potential risk to animals is negligible. The small quantities of hazardous materials onboard the HTV-2 vehicle are not expected to adversely affect marine mammals, sea turtles, and other marine life.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on biological resources would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.3.2 of the EA.
Health and Safety	HTV-2 test preparations at USAKA/RTS would not introduce new types of activities or increase levels of risk to support personnel. The proposed HTV-2 flight tests and impacts in the Marshall Islands would be conducted using the same USAKA/RTS range safety standards as those applied to ongoing ICBM hypersonic vehicle tests and other flight-test programs. Allowable risk limits for the general public would not exceed 1 in 1,000,000 for casualty to an individual from a single mission. Program personnel would follow established safety procedures when deployed in the BOA or to other RMI atolls.	The proposed HTV-2 program activities would not be implemented; therefore, project related impacts on health and safety would not occur. Conditions are not expected to change from that described for the Affected Environment in Section 3.3.3 of the EA.

3.0 AFFECTED ENVIRONMENT

This chapter describes the environmental resources at the installations and other locations identified in the Proposed Action—Vandenberg AFB, the over-ocean flight corridor, and USAKA/RTS and the Marshall Islands. The chapter is organized by installation/location, describing each environmental resource or topical area that could be affected at that site by implementing the Proposed Action. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating impacts. Sources of data used and cited in the preparation of this chapter include available literature (such as EAs, EISs, and other environmental studies), installation and facility personnel, and regulatory agencies. The rationale for excluding certain environmental resources from further study is described in the introductory section for each installation/location.

The information contained in this Chapter serves as the baseline against which the predicted effects of the Proposed Action can be compared. The potential environmental effects of the Proposed Action and No Action Alternative are discussed in Chapter 4.0.

3.1 VANDENBERG AIR FORCE BASE

Vandenberg AFB is located in Santa Barbara County on the central coast of CA, about 50 mi (240 km) northwest of the City of Santa Barbara (Figure 3-1). Covering more than 98,000 acres (39,660 hectares), it is the third largest USAF installation. A primary mission for the base is to conduct and support space and missile launches. Located along the Pacific coast, Vandenberg AFB is the only facility in the US from which unmanned Government and commercial satellites can be launched into polar orbit, and where land-based ICBMs can be launched to verify weapon system performance.

Figure 3-1. Location of Vandenberg AFB, CA

Rationale for Environmental Resources Analyzed

The proposed HTV-2 activities at Vandenberg AFB could impact air quality, noise, biological resources, cultural resources, health and safety, and hazardous materials and waste management (including pollution prevention), and as such, only these environmental resource topics are discussed. Although not broken out as a separate section, surface water quality is included in the analysis, from the standpoint of potential impacts on vegetation and wildlife, and wastewater generation was addressed under hazardous materials and waste management. Much of the information presented in this section was drawn from the Affected Environment chapter of the OSP EA (USAF, 2006). Pertinent new information was included where applicable to account for changes in the affected environment or the availability of updated data.

Some resource topics were not analyzed further at Vandenberg AFB because: (1) the Proposed Action does not require ground-disturbing activities, thus no impacts to soils would be expected; (2) Installation Restoration Program studies have generally not shown any long-term concerns for contamination to groundwater from repeated launches of similar solid-propellant systems (USAF, 2006); (3) there would be little increase in personnel on base, thus no socioeconomic concerns are anticipated; (4) given the launch trajectories of the proposed HTV-2 flight tests, the protection provided by range safety regulations and procedures, and the occurrence of launch noise over a wide area, there would be no disproportionate impacts to minority populations and low-income populations under Executive Order 12898 (*Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations*); (5) launch operations would be conducted in accordance with Western Range operating procedures and would not expand or alter currently controlled airspace; and (6) the proposed launches represent activities that are consistent with the *Vandenberg Air Force Base General Plan* (VAFB, 2007c) and well within the limits of current base operations. The California Coastal Commission (CCC) also found launch operations at the SSI Commercial Spaceport to be consistent with the California Coastal Management Program (CCC, 1994; USAF, 1995). As a result, there would be no adverse effects on land use, utilities, or transportation.

3.1.1 AIR QUALITY

The US Environmental Protection Agency (USEPA), the CARB, and the SBCAPCD, regulate air quality in Santa Barbara County and at Vandenberg AFB. The Clean Air Act (42 USC 7401-7671), as amended, gives USEPA the responsibility to establish the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) that set acceptable concentration levels for seven criteria pollutants: particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O_3), and lead (Pb). In addition, the State of California instituted the California Ambient Air Quality Standards (CAAQS), which includes additional standards for the Federally identified criteria pollutants, as well as sulfates, hydrogen sulfide, vinyl chloride (chloroethene), and visibility reducing particles. Short-term standards (1-, 8-, and 24-hour periods) were established for pollutants that contribute to acute health effects, while long-term standards were established for pollutants that contribute to chronic health effects. The CARB monitors levels of criteria pollutants at representative sites throughout CA. Table 3-1 outlines the NAAQS, CAAQS, and ambient concentrations of the criteria pollutants as measured by monitoring stations at Vandenberg AFB and in nearby Santa Maria. These concentrations are conservative estimates of the air-quality conditions at Vandenberg AFB.

Air-Quality Control Regions (AQCRs) that exceed the NAAQS and CAAQS are designated *nonattainment* areas and those in accordance with the standards are *attainment* areas. Vandenberg AFB is in the South Central Coast Intrastate AQCR (AQCR 032) (40 CFR 81.166). Both the USEPA and CARB designated Santa Barbara County as being in attainment of all Federal and state standards except for the

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, CA

Pollutant	2004		2005		2006		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
Ozone (parts per million [ppm])									
1-hour highest[5]	0.09	0.074	0.072	0.063	0.070	0.064	0.09	-	-
1-hour 2nd highest	0.089	0.064	0.067	0.062	0.063	0.063	-	-	-
8-hour highest[6]	0.083	0.064	0.066	0.061	0.063	0.062	0.070	0.075	Same as Primary Standard
8-hour 2nd highest	0.079	0.059	0.061	0.050	0.060	0.058	-	-	-
CO (ppm)									
1-hour highest	0.3	2.4	0.9	1.7	0.3	1.5	20	35	-
1-hour 2nd highest	0.3	1.8	0.9	1.6	0.3	1.5	-	-	-
8-hour highest	0.3	0.9	0.7	0.9	0.3	0.7	9	9	-
8-hour 2nd highest	0.3	0.9	0.6	0.8	0.3	0.7	-	-	-
NO_2 (ppm)									
1-hour highest	0.023	0.05	0.019	0.048	0.016	0.037	0.18	-	-
1-hour 2nd highest	0.023	0.045	0.019	0.045	0.016	0.035	-	-	-
Annual Arithmetic Mean	0.001	0.010	0.010	0.001	0.001	0.008	0.030	0.053	Same as Primary Standard
SO_2 (ppm)									
1-hour highest	0.009		0.004		0.007		0.25	-	-
1-hour 2nd highest	0.006		0.003		0.005		-	-	-
3-hour highest	0.003	*(no data)*	0.003	*(no data)*	0.005	*(no data)*	-	-	0.50
3-hour 2nd highest	0.003		0.003		0.003		-	-	-
24-hour highest	0.002		0.002		0.002		0.04	0.14	-
24-hour 2nd highest	0.002		0.001		0.002		-	-	-
Annual Arithmetic Mean	0.001		0.001		0.001		-	0.03	-
PM_{10} (micrograms per cubic meter [µg/m^3])									
24-hour highest	37	52	41	43	55	54	50	150	Same as Primary Standard
24-hour 2nd highest	37	46	37	38	43	49	-	-	-
Annual Arithmetic Mean	18	24	15	21	18	22	20	-	-

Table 3-1. Air Quality Standards and Ambient Air Concentrations at or near Vandenberg AFB, CA

Pollutant	2004		2005		2006		California Standards[1]	Federal Standards[2]	
	South VAFB	Santa Maria	South VAFB	Santa Maria	South VAFB	Santa Maria		Primary[3]	Secondary[4]
$PM_{2.5}$ (μg/m^3)									
24-hour highest		17		30		14	-	65 (35)[7]	Same as Primary Standard
24-hour 2nd highest	*(no data)*	13	*(no data)*	18	*(no data)*	13	-	-	-
Annual Arithmetic Mean		7.6		8		7.5	12	15	Same as Primary Standard

Notes:

[1] California standards for ozone, carbon monoxide, sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and particulate matter are not to be exceeded values.

[2] National averages (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year, with a maximum hourly average concentration above the standard, is equal to or less than one.

[3] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects from a pollutant.

[5] Not to be exceeded on more than an average of 1 day per year over a 3-year period.

[6] Not to be exceeded by the 3-year average of the annual 4th highest daily maximum 8-hour average.

[7] Although not fully implemented, the USEPA has reduced the $PM_{2.5}$ NAAQS from 65 to 35 μg/m^3.

Sources: 17 California Code of Regulations (CCR) 70200; 40 CFR Part 50; 73 FR 16436-16514; USEPA, 2007a.

8-hour O_3 CAAQS and the PM_{10} CAAQS (40 CFR 81.305; SBCAPCD, 2009a). For PM_{10}, the nonattainment is reflected in the locally recorded values shown in Table 3-1. Although the monitoring stations in the vicinity of Vandenberg AFB do not reflect an exceedance for O_3 CAAQS, other monitoring stations within the county have recorded higher levels; hence the nonattainment status for O_3 CAAQS. Because air quality is measured and regulated on a regional level, and O_3 forms in the atmosphere some distance from the location of their precursors' emission, the region of influence (ROI) for the air quality analysis is AQCR 032, Santa Barbara County, and the immediate offshore area.

SBCAPCD maintains a comprehensive inventory of air pollutants released within the county. This inventory accounts for types and amounts of pollutants emitted from a wide variety of sources, including on-road motor vehicles, fuel combustion at industrial facilities, solvent and surface coating usage, consumer product usage, and emissions from natural sources. The emission inventory is used to describe and compare contributions from air pollution sources, evaluate control measures, schedule rule adoptions, forecast future pollution, and prepare clean air plans. Tables 3-2 and 3-3 provide the latest available information on the overall emissions for Santa Barbara County. Emission levels of NO_x and VOC are of particular importance because of their contribution to ground level ozone and smog.

Table 3-2. 2001 Area and Point Source Emissions for Santa Barbara County, CA (Tons per Year)

Source	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area Sources	130,199	13,356	16,500	5,249	280	23,919
Point Sources	1,548	1,564	554	289	1,021	835
Total	**131,747**	**14,920**	**17,054**	**5,538**	**1,301**	**24,754**

Source: USEPA, 2007a.

Table 3-3. 2002 Ozone Precursor Emissions for Santa Barbara County, CA (Tons per Year)

NO_x	VOC
16,111	43,140

Source: SBCAPCD, 2007.

Stationary sources of air emissions on Vandenberg AFB (including both point and area sources) include abrasive blasting operations, boilers, generators, surface coating operations, turbine engines, wastewater treatment plants, storage tanks, aircraft operations, soil remediation, launch vehicle fueling operations, large aircraft starting systems, and solvent usage. On-base mobile sources of air emissions include various aircraft, missile and spacecraft launches, and numerous Government and personal motor vehicles (VAFB, 2005). Table 3-4 provides information on the overall emissions for Vandenberg AFB in 2006. Notably, the base emissions constitute less than 0.5 percent of the total countywide emissions of all criteria pollutants.

At Vandenberg AFB, wind and other meteorological conditions are critical for the dispersion of emissions. The mean annual wind speed in the area is 7 miles per hour (mph) (11.3 kilometers per hour [kph]) out of the northwest. The strongest winds occur during the winter and midday, and at ridgelines.

Table 3-4. 2006 Criteria Air Pollutant Emissions for Vandenberg AFB, CA (Tons per Year)					
CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
1,076.0	216.4	11.8	4.1	2.93	140.1

Source: CARB, 2009a; VAFB, 2007b.

Over half of the time, the wind blows at speeds greater than 7 mph (11.3 kph). The entire south-central coastal region experiences a persistent subsidence inversion resulting from a Pacific high-pressure region. The average maximum daily inversion height ranges from 1,600 ft (488 m) during the summer to 2,800 ft (853 m) during the winter. (USAF, 1998)

3.1.2 NOISE

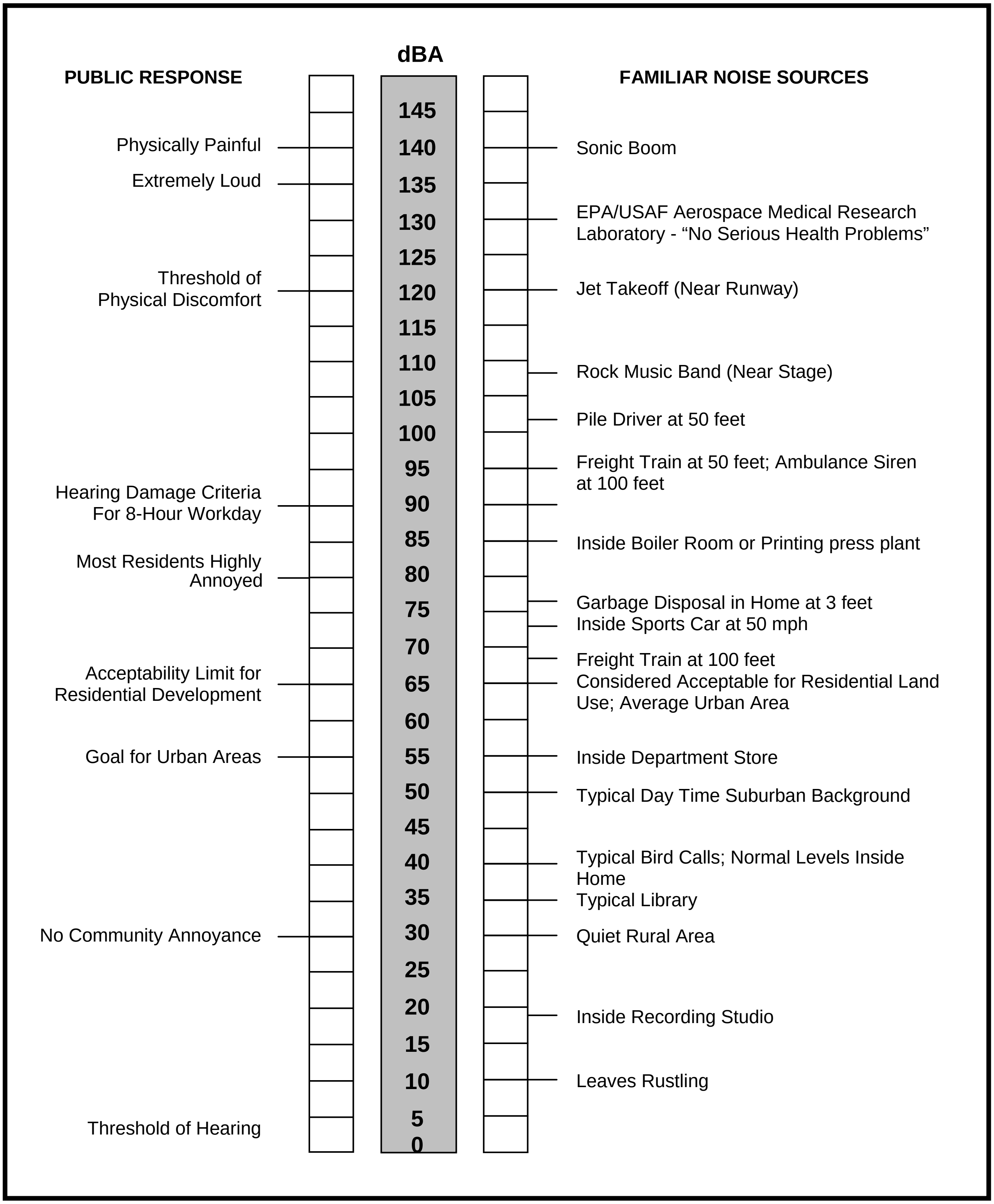
Noise is most often defined as unwanted sound that is heard by people or wildlife and that interferes with normal activities or otherwise diminishes the quality of the environment. Sources of noise may be transient (e.g., a passing train or aircraft), continuous (e.g., heavy traffic or air conditioning equipment), or impulsive (e.g., a sonic boom or a pile driver). Sound waves traveling outward from a source exert a sound pressure measured in dB.

The human ear is not equally sensitive to all sound wave frequencies. Sound levels adjusted for frequency-dependent amplitude are called “weighted” sound levels. Weighted measurements emphasizing frequencies within human sensitivity are called A-weighted decibels (dBA). Established by the American National Standards Institute, A-weighting significantly reduces the measured pressure level for low-frequency sounds, while slightly increasing the measured pressure level for some high-frequency sounds. In summary, A-weighting is a filter used to relate sound frequencies to human-hearing thresholds. Typical A-weighted sound levels measured for various sources are provided in Figure 3-2.

The greatest sound pressure level recorded during a specific period of time is termed the peak sound pressure level, further qualified as weighted or unweighted (i.e., unfiltered). Peak sound values can be too short and at a frequency missed by the human ear. Sound Exposure Level (SEL), however, is a composite cumulative energy metric of a sound’s amplitude and duration, and is qualified as weighted or unweighted. If the SEL is A-weighted, then it is referred to as ASEL, which is one of the most common metrics used for determining noise exposure effects on humans.

USAF standards require hearing protection whenever a person is exposed to steady-state noise of 85 dBA or more, or impulse noise of 140 dB sound pressure level or more, regardless of duration. Personal noise protection is required when using noise-hazardous machinery or entering hazardous noise areas.

Air Force Occupational Safety and Health (AFOSH) Standard 48-20 (*Occupational Noise and Hearing Conservation Program*) describes the USAF Hearing Conservation Program procedures used at Vandenberg AFB. Similarly, under 29 CFR 1910.95, employers are required to monitor employees whose exposure to noise could equal or exceed an 8-hour time-weighted average of 85 dBA. For off-base areas, Vandenberg AFB follows state regulations concerning noise, and maintains a Community Noise Equivalent Level (CNEL) of 65 dBA or lower. CNELs represent day-night noise levels averaged over a 24-hour period, with “penalty” decibels added to quieter time periods (i.e., evening and nighttime). As a result, the CNEL is generally unaffected by the short and infrequent rocket launches occurring locally on base.



Source: Modified from USASDC, 1991.

Figure 3-2. Typical Noise Levels of Familiar Noise Sources and Public Responses

For noise analysis purposes in this EA, the ROI at Vandenberg AFB is defined as the area within the 85-dB ASEL contour generated by the proposed HTV-2 launches (see Figure 4-1). This ROI equates to an area within a few miles of the launch site.

Typical noise sources at Vandenberg AFB are automobile and truck traffic, aircraft operations (including landings, takeoffs, and training approaches and departures for both fixed-wing and rotary-wing aircraft), and trains passing through the base (an average of 10 trains per day) (VAFB, 2005). Existing noise levels on base are generally low, with higher levels occurring near industrial facilities and transportation routes.

The immediate area surrounding Vandenberg AFB is largely composed of undeveloped and rural land, with some unincorporated residential areas in the Lompoc and Santa Maria valleys, and Northern Santa Barbara County. A small number of industrial areas and small airports are located within the Cities of Lompoc and Santa Maria (Figure 3-1), which are the two main urban areas in the region. Sound levels measured for these areas are typically low, but higher levels occur in the industrial areas and along transportation corridors. The rural areas of the Lompoc and Santa Maria valleys typically have low overall CNELs, normally about 40 to 45 dBA (USAF, 1998). Occasional aircraft flyovers can increase noise levels for a short period of time.

Other less frequent, but more intense, sources of noise in the region are from missile and space launches at Vandenberg AFB. These include Minotaur, Atlas V, and Delta IV launches from the South Base area, as well as Minuteman, Ground-based Midcourse Defense, Taurus, and Delta II launches from the North Base area. Depending on the launch vehicle and launch location on the base, resulting noise levels in Lompoc may reach an estimated maximum unweighted sound pressure level of 100 dB, and Santa Maria may reach 95 dB, each for an effective duration of about 20 seconds per launch. Equivalent A-weighted sound levels would be lower. Because launches from Vandenberg AFB occur infrequently, and the launch noise generated from each event is of very short duration, the average (CNEL) noise levels in the nearby areas are not affected. (USAF, 1998, 2000, 2006)

Although rocket launches from Vandenberg AFB often produce sonic booms during the vehicle's ascent, the resulting overpressures are directed out over the ocean in the direction of the launch azimuth and generally do not affect the CA coastline. Depending on the launch azimuth, some launches from South Vandenberg can cause sonic booms to occur over portions of the northern Channel Islands (USAF, 1995, 1998, 2000).

3.1.3 BIOLOGICAL RESOURCES

For purposes of analyzing biological resources at Vandenberg AFB, the ROI includes those land areas and near-shore waters near the SSI Commercial Spaceport (SLC-8) and associated launch azimuths (see Figure 2-3). Biological resources within deeper waters and the open ocean are described in Section 3.2.2.

3.1.3.1 Vegetation

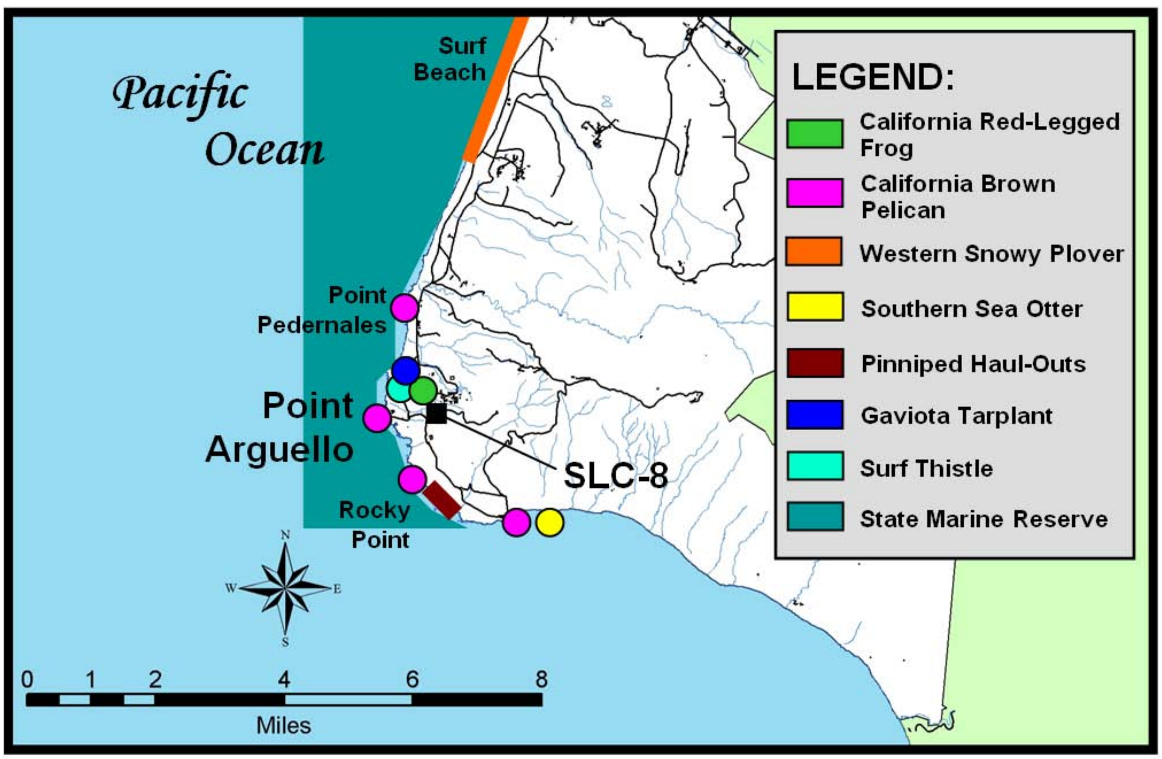
Vandenberg AFB supports a wide variety of vegetation organized according to habitat types. These include Bishop pine forest, Tanbark oak forest, coastal live oak woodland, riparian woodland, chaparral, coastal sage scrub, purple sage scrub, coastal dune scrub, coastal bluff scrub, coastal strand, grasslands, coastal bluffs, and rocky headlands. Approximately 85 percent of Vandenberg AFB vegetation is natural, with the balance either invasive vegetation that has replaced natural flora (particularly non-native annual grasslands) or plants associated with developments. Most of the vegetation surrounding SLC-8 is maintained to reduce fire hazard. (USAF, 2006; VAFB, 2005)

Several plants designated as Species of Concern[3] may be found near the SSI Commercial Spaceport and are listed in Appendix B. Habitat types and known locations are also identified.

3.1.3.2 Wildlife

The various coastal environments and vegetation types found at Vandenberg AFB provide a wide range of habitats for many resident and migratory animals. While some species are associated with a specific habitat, others may be generalists, occupying multiple habitat communities. Such examples occurring near SLC-8 may include the western fence lizard, garter snake, brush rabbit, mule deer, Townsend's western big-eared bat, California ground squirrel, and red-tailed hawk (USAF, 2006). A number of birds and other animals found on base are designated Species of Concern. These and other protected species potentially occurring near the Commercial Spaceport are listed in Appendix B, including their habitat type and known locations of occurrence on base.

Surveys conducted on base have shown a large number of seabirds—including pigeon guillemots, pelagic cormorants, Brandt's cormorants, black oystercatchers, and western gulls—to occur around Point Arguello (Figure 3-3) (USAF, 2006). These and other bird species found on base, including most of those listed in Appendix B, are given additional protections under the Migratory Bird Treaty Act.



Source: CDFG, 2009; USAF, 2006.

Figure 3-3. Protected Species and Sensitive Habitat near SLC-8 at Vandenberg AFB, CA

[3] Species of Concern status applies to plants and animals not listed under the Federal Endangered Species Act (as amended) or the State-level Endangered Species Act, but for which concerns for the future well-being of the taxon exist.

Regarding marine mammals, some species of seals and sea lions (pinnipeds) can be found within the ROI using beaches and rocky shores along Vandenberg AFB to rest, molt, and/or breed. Pinnipeds that may be found onshore ("hauled-out") within the ROI include the California sea lion, Pacific harbor seal, and northern elephant seal (USAF, 2006). None of these species are listed as endangered or threatened, but all receive Federal protection from harassment or injury under the Marine Mammal Protection Act (MMPA).

The Pacific harbor seal is the most common marine mammal inhabiting Vandenberg AFB, occurring year-round at several locations along the base coastline, particularly at Rocky Point (Figure 3-3). Pupping occurs from March 1 through June 30. Harbor seals are considered particularly sensitive to disturbance during this period, when the risk of mother-offspring separation is greatest. To assess the potential long-term effects of launch noise on pinnipeds, Vandenberg AFB conducts biological monitoring for all launches during the harbor seal pupping season (March 1 to June 30). (74 FR 6236-6244; USAF, 2006)

Fewer than 200 California sea lions are found seasonally on Vandenberg AFB. Sea lions may sporadically haul-out to rest when in the area to forage or when transiting the area, but generally spend little time there. They can be found in the area of Point Pedernales, Point Arguello, and Rocky Point (Figure 3-3). In 2003, at least 142 sea lions and 5 pups were hauled out at Rocky Point. This occurrence was the first report of sea lions being born at Vandenberg, but it may have been a result of the El Nino conditions that existed at that time. (69 FR 5720-5728; USAF, 2006)

Approximately 150 northern elephant seals may be found seasonally on Vandenberg AFB. Weaned elephant seal pups making their first foraging trips occasionally haul-out for 1 to 2 days at the base before continuing on their migration. In April 2003, approximately 88 juveniles and young adult females began to haul-out at Rocky Point to molt. (69 FR 5720-5728; USAF, 2006)

3.1.3.3 Threatened and Endangered Species

Those threatened and endangered species found in proximity to the proposed HTV-2 launch site (SLC-8) are listed in Table 3-5. Although not all inclusive, locations of these species are also shown in Figure 3-3.

3.1.3.3.1 Listed Floral Species

Vandenberg AFB represents an important habitat for threatened and endangered plant species because human activities and invasive species are controlled on the base. Two listed species are known to occur near SLC-8.

The Federally endangered Gaviota tarplant is found at several locations on base, including one area located one mile from SLC-8 (USAF, 2006). Mowed and unmowed non-native grassland and ruderal vegetation represent suitable habitat for Gaviota tarplant. Overall, the USAF permanently removed at least 4.8 acres (1.9 hectares) of Gaviota tarplant on base through mission-critical activities. The USFWS, however, recently concluded that the tarplant population is stable throughout its range (67 FR 67968-68001; USFWS, 2007).

The state threatened surf thistle occurs within 0.8 mi (1.3 km) of SLC-8. Suitable habitat for surf thistle is found primarily in the coastal dunes. (USAF, 2006)

Table 3-5. Threatened and Endangered Species near SLC-8 at Vandenberg AFB, CA[1]			
Common Name	**Scientific Name**	**Federal Status**	**CA Status**
Plants			
Gaviota tarplant	*Dienandra increscens ssp. villosa*	E	E
Surf thistle	*Cirsium rhothophilum*	-	T
Reptiles/Amphibians			
California red-legged frog	*Rana aurora draytonii*	T	SOC
Birds			
California brown pelican	*Pelecanus occidentalis californicus*	E	E, CFP
Western snowy plover	*Charadrius alexandrinus nivosus*	T	SOC
Mammals (includes nearshore waters)			
Southern sea otter	*Enhydra lutris nereis*	T	CFP

Notes:
[1] The species listed are known to occur or are expected to occur year round or seasonally within approximately 2.0 mi (3.2 km) of SLC-8 and the associated launch azimuths except for the western snowy plover, which occurs within 3.9 mi (6.2 km) of SLC-8 and the launch azimuth.

E = Endangered CFP = California Fully Protected
T = Threatened SOC = Species of Concern

Source: USAF, 2006.

3.1.3.3.2 Listed Faunal Species

Three Federally listed wildlife species occur within the ROI at Vandenberg AFB. Discussions on each species are provided in the paragraphs that follow.

The California red-legged frog prefers freshwater ponds and streams, usually with moderately deep pools, permanent water, and dense aquatic vegetation within and along water edges. Red-legged frogs are common on Vandenberg AFB and are found almost any place where suitable habitat exists. These locations include the wastewater retention ponds located approximately 1,310 ft (400 m) northwest of SLC-8. (USAF, 2006; USFWS, 1999)

The endangered California brown pelican roosts mostly along rocky shores along the base coastline, particularly at or near Point Arguello (USAF, 2006).

Vandenberg AFB provides important nesting and wintering habitat for western snowy plovers. Plover nesting occurs on the coastal dunes of the base, including the area of Surf Beach along the South Vandenberg coastline (see Figure 3-3). Nesting and chick rearing activity generally occurs between March 1 and September 30 (USAF, 2006).

The only listed marine mammal occurring at Vandenberg AFB is the Federally threatened southern sea otter, which can be observed year-round foraging and rafting within a few hundred yards of the shore anywhere kelp beds are present. Resident breeding colonies exist along the South Base coastline from an area east of Rocky Point to the southern base boundary. Up to 60 otters, including pups, have been seen along the southern coastline. (USAF, 2006)

Although the Federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*) is reported to occur at various locations on base, there is no known habitat for the butterfly within 3.0 mi (4.8 km) of the SLC-8 launch site, which is beyond the known dispersal distance for this species (Evans, 2009; MDA, 2008).

3.1.3.4 Environmentally Sensitive Habitats

In cooperation with the USFWS and the California Department of Fish and Game (CDFG), Vandenberg AFB identified habitats for special protection under its Integrated Natural Resources Management Plan (INRMP) (draft). Although no USFWS-designated critical habitat areas exist on Vandenberg AFB for the Gaviota tarplant or for other protected plant species, the base has made a commitment to develop and implement protective measures to be specified in its updated INRMP. These measures may include monitoring, surveys, habitat enhancement, and restoration areas (67 FR 67968-68001; USAF, 2006).

Nesting habitat for western snowy plovers can be found along the beaches and coastal dunes of Vandenberg AFB. To better protect the snowy plovers during the nesting season, Vandenberg AFB and the USFWS have drafted a recovery plan that includes closing areas of Surf Beach (see Figure 3-3) to human access. Beach and dune closures are implemented each nesting season (USAF, 2006).

In 1999, the State of California enacted the Marine Life Protection Act. The Act requires the state to implement a Marine Life Protection Program, which includes a network of Marine Protected Areas (MPAs). MPAs represent discrete geographic marine or estuarine areas set aside primarily to protect or conserve marine life and habitat. In April 2007, the California Fish and Game Commission approved MPAs in the CA Central Coast Region, including the Vandenberg State Marine Reserve (SMR) along the central and south coasts of Vandenberg AFB (see Figure 3-3). Effective September 21, 2007, the take[4] of any living marine resource within the SMR is prohibited except for a take incidental to base operations and commercial space launch operations identified as mission critical by the Vandenberg AFB Commander. As part of the Marine Life Protection Program, the CDFG will enter into a Memorandum of Understanding with the base Commander for the mutually beneficial management and administration of the Vandenberg SMR. (CDFG, 2009)

As amended and reauthorized in 2006, Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-297) requires regional Marine Fisheries Councils to manage fisheries to ensure stability of fish populations with support from the NMFS. Regional Marine Fisheries Councils prepare Fishery Management Plans that identify and protect the habitat essential to maintain healthy fish populations. Commercially important species are preferentially targeted. Threats to habitat from both fishery and non-fishery activities are identified, and actions needed to eliminate them are recommended. In CA, the Pacific Fishery Management Council (PFMC) is responsible for identifying essential fish habitat, which is generally defined as the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. (PFMC, 2009)

Fishes of commercial importance found just within and downrange from the ROI include coastal pelagic schooling squids and fishes (Pacific sardine, Pacific mackerel, and northern anchovy), groundfish (rockfish, flatfish, and Pacific whiting), and large, highly migratory pelagic fishes (tuna, swordfish, and sharks). Essential fish habitat identified by the PFMC for these species includes all marine and estuary waters from the coast of CA to the limits of the Exclusive Economic Zone, which extends 200 mi (322

[4] The California Fish and Game Code Section 1-89.1(86) defines "take" as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." For purposes of the Marine Life Protection Act, Section 1.80 of Title 14 CCR defines "take" as to "hunt, pursue, catch, capture or kill fish, amphibians, reptiles, mollusks, crustaceans or invertebrates or attempting to do so."

km) seaward from the coast. Groundfish are the species of commercial importance found within the shallow waters off Vandenberg AFB. More than 82 species of groundfish are identified in the Fishery Management Plan for this region. (PFMC, 2009)

3.1.4 CULTURAL RESOURCES

Cultural resources include prehistoric and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. Cultural resources are limited, nonrenewable resources whose potential for scientific research (or value as a traditional resource) may be easily diminished by actions impacting their integrity.

Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of Federal undertakings. These laws and regulations stipulate a process of compliance and consultation, define the responsibilities of the Federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., SHPO and the Advisory Council on Historic Preservation). In addition to NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the National Historic Preservation Act (especially Sections 106 and 110), the Archaeological Resources Protection Act, the Antiquities Act of 1906, the American Indian Religious Freedom Act, and the Native American Graves Protection and Repatriation Act. Depending on the integrity and historical significance of a site or property, it may be listed or eligible for listing on the NRHP.

The term ROI is synonymous with the "area of potential effect" as defined under cultural resources regulations, 36 CFR 800.16(d). In general, the ROI for cultural resources encompasses areas of planned ground disturbance (e.g., areas of new facility/utility construction) and all buildings or structures requiring modification, renovation, demolition, or abandonment. For the HTV-2 program, no soil disturbance is planned to occur on base and only minor modifications would be made to buildings. Thus, the ROI for the HTV-2 Proposed Action consists of those buildings and facilities that are historic as well as adjacent areas where archaeological resources might occur. In cases of launch failures, the ROI would include areas of debris clean-up, firefighting, and other required post launch-anomaly activities.

3.1.4.1 Archaeological Sites

Numerous archaeological surveys at Vandenberg AFB have identified more than 2,200 prehistoric and historic cultural sites. Prehistoric sites have included dense shell middens (refuse heaps), stone tools, village sites, stone quarries, and temporary encampments (VAFB, 2005). One of the existing facilities that would be potentially used for activities under the Proposed Action (see Section 2.1.2.1) is located near a known archaeological site (Table 3-6).

Table 3-6. Archaeological Sites in Relation to Proposed HTV-2 Support Facilities at Vandenberg AFB, CA

Facility	Site Characteristics	NRHP Eligibility	Proximity to Facility
Rail Transfer Facility (Facility 1886)	Historic – Scatter of historic artifacts possibly associated with a railroad camp or the sugar beet industry.	Not Determined	The site was discovered during construction monitoring for Facility 1886. The site was on the rail approaches to the facility.

Source: USAF, 2006.

3.1.4.2 Historic Buildings and Structures

As part of the World War II effort, the US Army acquired much of the current base area in 1941. The area, named Camp Cooke, served as a training area for armored and infantry units. In 1950, the base was re-activated in support of the Korean War. In 1957, the USAF took over the northern 65,000 acres of Camp Cooke and renamed it "Cooke AFB." It was later renamed Vandenberg AFB in a ceremony held on October 4, 1958.

Since the late-1950s, the base has been used primarily to develop several types of intermediate and long-range ballistic missiles, and to launch both military and civilian payloads into space. A multi-year survey completed in 1996 identified more than 70 sites, complexes, and facilities that have been determined eligible for the NRHP as historic Cold War-era sites (USAF, 2006). Table 3-7 lists the Cold War sites that could be affected by the Proposed Action.

Table 3-7. Cold War Sites Potentially Affected by HTV-2 Activities at Vandenberg AFB, CA

Facility	NRHP Eligibility	Contributing Elements
Integration Refurbishment Facility (Building 1900)	Eligible	None
Rail Transfer Facility (Facility 1886)	Eligible	None

Source: USAF, 2006.

3.1.4.3 Native American Traditional Resources

At the time of sustained European contact in the early 1800s, the Vandenberg AFB area was occupied by inhabitants who spoke one of the major languages of the Chumashan branch of the Hokan language family. Several villages were located in the area that is now North Vandenberg AFB. (USAF, 1998)

Today, Chumash-related traditional resources at Vandenberg AFB consist of both Traditional Cultural Properties and "traditional resource areas." Known Traditional Cultural Properties on base include sacred sites, rock art sites, archaeological sites, and ancestral burial locations. The traditional resource areas on base are those locations that modern-day Native Americans access to collect raw materials (e.g., reeds, plants, minerals, and rock resources) or other items of interest. Preservation of this cultural and natural record is important to the living Chumash because of their respect for ancestors, ancestral lands, and traditional resources, as well as the importance of perpetuating Chumash society and traditional ways. (Carucci, 2007; VAFB, 2005)

Although various traditional resources are known on Vandenberg AFB, none of these sites are within the ROI for proposed HTV-2 program activities.

3.1.5 HEALTH AND SAFETY

Regarding health and safety at Vandenberg AFB, the ROI is limited to the US transportation network used in shipping rocket motors to the base, existing base facilities supporting the HTV-2 flight tests, off-base areas within launch hazard zones, and areas downrange along the launch vehicle's flight path. The health and safety ROI includes base personnel, contractors, and the general public.

Air Force Policy Directive 91-2 (*Safety Programs*) establishes the USAF's key safety policies and also describes success-oriented feedback and performance metrics to measure policy implementation. More specific safety and safety-related DOD requirements, Air Force Instructions (AFIs), and other requirements and procedures pertaining to the handling, maintenance, transportation, and storage of rocket motors, and related ordnance, are listed below:

- DOD 6055.09-STD (*DOD Ammunition and Explosives Safety Standards*)
- AFI 91-202, Air Force Space Command (AFSPC) Supplement 1 (*The US Air Force Mishap Prevention Program*)
- Air Force Manual 91-201 (*Explosives Safety Standards*).

Interstate highways are the preferred routes for the transportation of rocket components to the launch facility, although some local and state routes may be used. The Minotaur IV Lite 1st-stage motor, however, would most likely be shipped to Vandenberg AFB by rail. The health and safety of travel on US transportation corridors is under the jurisdiction of each State's Highway Patrol and DOT, and the US DOT. The USAF coordinates with each state DOT whenever the transport of hazardous missile/launch vehicle components is planned.

The USAF has an excellent safety record of transporting rocket motors. As an example, for ICBM systems, approximately 500,000 road miles have been driven carrying Minuteman and Peacekeeper missiles and motors between bases and launch facilities in the field. During the height of Minuteman ICBM Program operations (from the early 1960s to 1990), over 11,000 missile movements involving over 12,400 individual rocket motors occurred by air, rail, or road. Since 1962, there have been only four accidents associated with these movements—all of them transport truck rollover scenarios involving Minuteman systems. In each of these cases, however, all USAF property was safely recovered and there was no damage to the environment or to human health. Additionally, there were no traffic incidents during a program in which the USAF transported 150 boosters between 1995 and 1997. No accidents or rollovers occurred during the transport of the larger Peacekeeper systems. At FE Warren AFB, Wyoming, for example, the accident rate for USAF vehicles within the ICBM Wing area (about 0.000002 accidents per mile driven) was shown to be nearly identical to the accident rate for the entire state. (*Air Force Times*, 2008; USAF, 2004, 2006)

Health and safety requirements at Vandenberg AFB include industrial hygiene, which is the joint responsibility of Bio-Environmental Services and the 30 Space Wing (SW) Safety Office. These responsibilities include monitoring worker exposure to workplace chemicals and physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety includes both occupational and public safety. Both AFOSH and applicable OSHA regulations and standards are used to implement safety and health requirements for all workers on base, including military personnel and contractors.

Final responsibility and authority for the safe conduct of ballistic and space vehicle operations lies with the 30 SW Commander. Establishing and managing the overall safety program is the responsibility of the 30 SW Safety Office, which ensures safety during launch operations at Vandenberg AFB.

The AFSPC Manual 91-710 (*Range Safety User Requirements*) establishes range safety policy, and defines requirements and procedures for ballistic and space vehicle operations at Vandenberg AFB (AFSPC, 2004). Over-ocean launches must comply with DOD Instruction 4540.01 (*Use of International Airspace by US Military Aircraft and for Missile/Projectile Firings*).

Prior to conducting rocket launches, all launch operations are evaluated by the 30 SW Safety Office to ensure that populated areas, critical range assets, and civilian property susceptible to damage are outside predicted impact/debris limits. These actions include a review of flight trajectories and hazard area dimensions, and review and approval of destruct systems. Criteria used to determine launch debris hazard risks are in accordance with the RCC Standard 321-07, *Common Risk Criteria Standards for National Test Ranges* (RCC, 2007).

Atmospheric dispersal modeling is also conducted to ensure emission concentrations from each launch do not exceed certain levels outside controlled areas. In accordance with 30 Space Wing Instruction (SWI) 91-106 (*Toxic Hazard Assessments*), if hydrogen chloride (HCl) launch emission cloud concentrations of 10 ppm or higher are predicted to cross the base land boundary, then the launch is held until meteorological conditions improve.

A NOTMAR and a NOTAM are published and circulated in accordance with 30 SWI 91-104 (*Operations Hazard Notice*) to warn personnel to avoid potential impact areas within established range Warning Areas off the coast, and in other international waters and airspace. Resources such as radar, ground roving security forces, and/or helicopter support are used prior to operations to ensure evacuation of non-critical personnel. Nearby access roads may be closed, and nearby recreational areas may be evacuated. Jalama Beach County Park, near the southern tip of the base, is closed on average once a year, while Ocean Beach County Park, between North and South Base, is closed on average three times per year under agreement with Santa Barbara County (USAF, 2006).

In accordance with 30 SWI 91-105 (*Evacuating or Sheltering of Personnel on Offshore Oil Rigs*), the USAF notifies oilrig companies of an upcoming launch event approximately 10 to 15 days in advance. The USAF's notification, provided through the Department of the Interior's Minerals Management Service, requests that the oilrigs located in the path of the launch vehicle overflight temporarily suspend operations and evacuate or shelter their personnel.

The coordination and monitoring of train traffic passing through the base during hazardous operations is conducted in accordance with 30 SWI 91-103 (*Train Hold Criter*ia). An average of 10 trains pass through the base daily on the Southern Pacific line (VAFB, 2005).

Vandenberg AFB possesses significant emergency response capabilities that include its own Fire Department, Disaster Control Group, and Security Police Force, in addition to contracted support for handling accidental releases of regulated hypergolic propellants and other hazardous substances.

The Vandenberg AFB Fire Department approves and maintains the business plans and hazardous material inventories prescribed by the CA Health and Safety Code. The plans and inventories are developed by the organizations conducting business on the base. Additionally, the base Fire Department conducts on-site facility inspections, as required, to identify potentially-hazardous conditions that could lead to an accidental release. During launch operations, Fire Department response elements are pre-positioned to expedite response in the event of a launch anomaly. (USAF, 2006)

3.1.6 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

For the analysis of hazardous materials and waste management at Vandenberg AFB, the ROI is defined as those HTV-2 support facilities that: (1) handle and transport hazardous materials; (2) collect, store (on a short-term basis), and ship hazardous waste; and (3) are near existing Installation Restoration Program (IRP) sites or other contamination.

Hazardous materials and waste management activities at USAF installations are governed by specific environmental regulations. For the purposes of the following discussion, the term “hazardous materials or hazardous waste” refers to those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC Section 9601 et seq., as amended. In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to the public health, welfare, or the environment when released. Regulated under the Resource Conservation and Recovery Act (RCRA), 42 USC Section 6901 et seq., hazardous waste is further defined in 40 CFR 261.3 as any solid waste that possesses any of the hazardous characteristics of toxicity, ignitability, corrosiveness, or reactivity.

AFI 32-7042 (*Solid and Hazardous Waste Compliance*) and AFI 32-7086 (AFSPC Supplement 1) (*Hazardous Materials Management*) specify requirements for the development of procedures to manage hazardous materials and waste. In accordance with AFI 32-4002 (*Hazardous Materials Emergency Response Program*), each USAF installation must also develop a hazardous materials emergency response plan and procedures. These plans and procedures also incorporate appropriate Federal, state, local, and USAF requirements regarding the management of hazardous materials and hazardous waste, including pollution prevention.

On Vandenberg AFB, Air Force organizations are required to manage hazardous materials through the base’s HazMart Pharmacy. The HazMart is the single point of control and accountability for the requisitioning, receipt, distribution, issue, and reissue of hazardous materials. Hazardous materials obtained from off base suppliers are also coordinated through Vandenberg AFB’s HazMart Pharmacy. Hazardous materials are inventoried and tracked using Environmental Management System software. These procedures are in accordance with the base *Hazardous Materials Management Plan* (30 SW Plan 32-7086).

The prevention, control, and handling of any spills of hazardous materials are covered under Vandenberg’s *Spill Prevention, Control and Countermeasures Plan* (30 SW 32-4002-C) and *Hazardous Materials Emergency Response Plan* (30 SW Plan 32-4002-A). These plans ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material spill prevention, spill incidents, and associated emergency response are available to all installation personnel.

For hazardous waste, the base *Hazardous Waste Management Plan* (30 SW Plan 32-7043-A) describes the procedures for packaging, handling, transporting, and disposing of such wastes. If not reused or recycled, hazardous wastes are transported off base for appropriate treatment and disposal. Industrial wastewaters (including rain and wash water collected from launch pad catchments) are monitored and properly disposed of in accordance with the Vandenberg AFB *Wastewater Management Plan* (30 SW Plan 32-7041-A). All hazardous wastes are managed in accordance with RCRA requirements and with CA Hazardous Waste Control Laws. The transportation of hazardous materials and waste outside the base boundaries is governed by the US DOT regulations within 49 CFR 100-199.

As for IRP-related issues, no IRP or other contamination concerns have been identified at SLC-8, the proposed HTV-2 program launch site (Atta, 2008). Older buildings proposed for HTV-2 activities, however, may contain hazardous materials used in their construction, such as asbestos and lead-based paint (LBP). At Vandenberg AFB, LBP and asbestos are managed in accordance with 30 SW Plan 32-1002 (*Lead-Based Paint Management Plan*), 30 SW Plan 32-1052-A (*Asbestos Management Plan*), 32-1052-B (*Asbestos Operating Plan*), and other applicable Federal, state, local, and USAF requirements.

3.2 OVER-OCEAN FLIGHT CORRIDOR AND THE GLOBAL ENVIRONMENT

Because of the potential global effects of launching rockets over the ocean and through the earth's atmosphere, this EA also considers the environmental effects on the global environment in accordance with the requirements of Executive Order 12114. This section describes the baseline conditions within the HTV-2 over-ocean flight corridor that may be affected by the Proposed Action.

Rationale for Environmental Resources Analyzed

Because of the limited scope of the Proposed Action in the over-ocean flight corridor, the global atmosphere and the biological resources within the North Pacific were the only resource areas analyzed. Water quality and noise were also included in the analysis to account for potential impacts on marine life and some terrestrial (island) wildlife. Other environmental resources within the ROI were not evaluated in this EA because: (1) effects would be limited to the over-ocean flight corridor, thus, there is no potential for impacts to cultural resources, land use, soils, and groundwater; and (2) since the ROI is well removed from population centers, no impacts to socioeconomics, utilities, waste management, or transportation are anticipated, nor are environmental justice (Executive Order 12898) concerns expected. Although not discussed in these sections, health and safety-related issues in the flight corridor are addressed under Vandenberg AFB (Sections 3.1.5 and 4.1.1.5), and under USAKA/RTS and the Marshall Islands (Sections 3.3.3 and 4.1.3.3).

3.2.1 GLOBAL ATMOSPHERE

3.2.1.1 Stratospheric Ozone Layer

The stratosphere, which extends from 6 mi (10 km) to approximately 30 mi (50 km) in altitude, contains the Earth's ozone layer (National Oceanic and Atmospheric Administration [NOAA], 2008). The ozone layer plays a vital role in absorbing harmful ultraviolet radiation from the sun. Over the last 20 years, anthropogenic (human-made) gases released into the atmosphere—primarily chlorine related substances—have threatened ozone concentrations in the stratosphere. Such materials include chlorofluorocarbons (CFCs), which have been widely used in electronics and refrigeration systems, and the lesser-used Halons, which are extremely effective fire extinguishing agents. Once released, the motions of the atmosphere mix the gases worldwide until they reach the stratosphere, where ultraviolet radiation releases their chlorine and bromine components. Atomic chlorine (Cl) reacts directly with O_3 to form chlorine oxide (ClO) and molecular oxygen (O_2) (see equation 1). The ClO in turn can react with a free oxygen atom (O) to form more O_2 and a free Cl atom that is ready to attach to more O_3 molecules (see equation 2). A single Cl atom can destroy as many as 100,000 O_3 molecules during its residence in the stratosphere (Levi, 1988). This combination of reactions occurs throughout the stratosphere, and can be directly linked to global ozone depletion (Hemond, 1994).

Equation 1: $Cl + O_3 \rightarrow ClO + O_2$
Equation 2: $ClO + O \rightarrow Cl + O_2$

Through global compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and amendments, the worldwide production of CFCs and other ozone-depleting substances has been drastically reduced, and banned in many countries. A continuation of these compliance efforts is expected to allow for a slow recovery of the ozone layer (World Meteorological Organization [WMO], 2006).

3.2.1.2 Greenhouse Gases and Global Warming

GHG are components of the atmosphere that contribute to the greenhouse effect and global warming. Some GHG occur naturally in the atmosphere, while others result from human activities such as the burning of fossil fuels. Federal agencies, states, and local communities address global warming by preparing GHG inventories and adopting policies that will result in a decrease of GHG emissions. According to the Kyoto Protocol and the California Climate Action Registry, there are six GHGs: carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (CARB, 2009b; United Nations Framework Convention on Climate Change, 2008). Although the direct GHG (CO_2, CH_4, and N_2O) occur naturally in the atmosphere, human activities have changed GHG atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2004, concentrations of CO_2 have increased globally by 35 percent. Within the US, fuel combustion accounted for 94 percent of all CO_2 emissions released in 2005. On a global scale, fossil fuel combustion added approximately 30 x 10^9 tons (27 x 10^9 metric tons) of CO_2 to the atmosphere in 2004, of which the US accounted for about 22 percent (USEPA, 2007b).

Since 1900, the Earth's average surface air temperature has increased by about 1.2° to 1.4° Fahrenheit (F) (0.7° to 0.8° Celsius [C]). The warmest global average temperatures on record have all occurred within the past 15 years, with the warmest 2 years being 1998 and 2005 (USEPA, 2009). With this in mind, the DARPA and the USAF are poised to support climate-changing initiatives globally, while preserving military operations, sustainability, and readiness by working, where possible, to reduce GHG emissions (Air Force Center for Engineering and the Environment, 2005).

3.2.2 BIOLOGICAL RESOURCES

The affected environment for the over-ocean flight corridor is described in the following subsections in terms of its environmental setting, threatened and endangered species, and other protected species. For purposes of this analysis, the ROI is focused primarily on the two HTV-2 flight corridors over the North Pacific Ocean, where sonic booms and rocket motor drop zones might occur.

3.2.2.1 Open-Ocean Environment

The average ocean depth within much of the ROI is over 10,000 ft (3,056 m). Marine biological communities in the deep ocean waters can be divided into two broad categories: pelagic and benthic. Pelagic communities live in the water column and have little or no association with the bottom, while benthic communities live within, upon, or are otherwise associated with the bottom.

The organisms living in pelagic communities may be drifters (plankton) or swimmers (nekton). The plankton includes larvae of benthic species, so a pelagic species in one ecosystem may be a benthic species in another. The plankton consists of plant-like organisms (phytoplankton) and animals (zooplankton) that drift with the ocean currents, with little ability to move through the water on their own. The nekton consists of animals that can swim freely in the ocean, such as fish, squids, sea turtles, and marine mammals. Benthic communities are made up of marine organisms that live on or near the sea floor, such as bottom dwelling fish, shrimps, worms, snails, and starfish.

The North Pacific Ocean contains a number of threatened, endangered, and other protected species, including whales and small cetaceans, pinnipeds, and sea turtles. These are listed in Table 3-8 for areas within the ROI. Many of these species can be found off the West Coast of the US or near the Hawaiian Islands, but they are sometimes seasonal in occurrence because of unique migration patterns. Some species, particularly the larger cetaceans, can occur hundreds or thousands of miles from land.

Table 3-8. Protected Marine Mammal and Sea Turtle Species Occurring within the North Pacific Over-Ocean Flight Corridor

Common Name	Scientific Name	Federal Status
Pinnipeds		
Northern fur seal	*Callorhinus ursinus*	MMPA
Guadalupe fur seal	*Arctocephalus townsendi*	T
California sea lion	*Zalophus californianus*	MMPA
Pacific harbor seal	*Phoca vitulina richardsi*	MMPA
Northern elephant seal	*Mirounga angustirostris*	MMPA
Steller sea lion	*Eumetopias jubatus*	E
Hawaiian monk seal	*Monachus schauinslandi*	E
Small Cetaceans		
Harbor porpoise	*Phocoena phocoena*	MMPA
Dall's porpoise	*Phocoenoides dalli*	MMPA
Bottlenose dolphin	*Tursiops truncatus*	MMPA
Common dolphin	*Delphinus delphis*	MMPA
Spinner dolphin	*Stenella longirostris*	MMPA
Striped dolphin	*Stenella coeruleoalba*	MMPA
Northern right whale dolphin	*Lissodelphis borealis*	MMPA
Risso's dolphin	*Grampus griseus*	MMPA
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	MMPA
Pantropical spotted dolphin	*Stenella attenuata*	MMPA
Rough-toothed dolphin	*Steno bredanensis*	MMPA
Fraser's dolphin	*Lagenodelphis hosei*	MMPA
Short-finned pilot whale	*Globicephala macrorhynchus*	MMPA
Killer whale	*Orcinus orca*	MMPA
False killer whale	*Pseudorca crassidens*	MMPA
Pygmy killer whale	*Feresa attenuata*	MMPA
Dwarf sperm whale	*Kogia sima*	MMPA
Pygmy sperm whale	*Kogia breviceps*	MMPA
Melon-headed whale	*Peponocephala electra*	MMPA
Beaked Whales		
Cuvier's beaked whale	*Ziphius cavirostris*	MMPA
Longman's beaked whale	*Indopacetus pacificus*	MMPA
Blainsville's beaked whale	*Mesoplodon densirostris*	MMPA
Large Odontocetes and Baleen Whales		
Sperm whale	*Physeter macrocephalus*	E
Gray whale	*Eschrichtius robustus*	MMPA
Humpback whale	*Megaptera novaeangliae*	E
North Pacific right whale	*Eubalaena japonica*	E
Sei whale	*Balaenoptera borealis*	E
Blue whale	*Balaenoptera musculus*	E
Fin whale	*Balaenoptera physalus*	E
Bryde's whale	*Balaenoptera edeni*	MMPA
Minke whale	*Balaenoptera acutorostrata*	MMPA

Table 3-8. Protected Marine Mammal and Sea Turtle Species Occurring within the North Pacific Over-Ocean Flight Corridor (cont'd)		
Common Name	**Scientific Name**	**Federal Status**
Sea Turtles		
Green sea turtle	*Chelonia mydas*	T
Hawksbill sea turtle	*Eretmochelys imbricata*	E
Loggerhead sea turtle	*Caretta caretta*	T
Olive ridley sea turtle	*Lepidochelys oliveacea*	T
Leatherback sea turtle	*Dermochelys coriacea*	E

Notes:
MMPA = Protected under the Marine Mammal Protection Act
E = Endangered
T = Threatened
Source: NOAA, 2009a; USAF, 2006.

In the marine environment, there are many different sources of noise, both natural and anthropogenic. Biologically produced sounds include whale songs, dolphin clicks, and fish vocalizations. Natural geophysical sources include wind-generated waves, earthquakes, precipitation, and lightning storms. Anthropogenic sounds are generated by a variety of activities, including commercial shipping, geophysical surveys, oil drilling and production, dredging and construction, sonar systems, DOD test activities and training maneuvers, and oceanographic research. (USAF, 2006)

While measurements for sound pressure levels in air are referenced to 20 µPa, underwater sound levels are normalized to 1 µPa at 3.3 ft (1 m) away from the source, a standard used in underwater sound measurement. Within the ROI, some of the loudest underwater sounds generated are most likely to originate from storms, ships, and some marine mammals. The sound of thunder from lightning strikes can have source levels of up to 260 dB (re to 1 µPa). A passing supertanker can generate up to 190 dB (re to 1 µPa) of low frequency sound. For marine mammals, dolphins are known to produce brief echolocation signals over 225 dB (re to 1 µPa), while mature sperm whale clicks have been calculated as high as 232 dB (re to 1 µPa). (USAF, 2006)

3.2.2.2 Terrestrial (Atoll/Island) Environments

Along the HTV-2 over-ocean flight corridors, the ROI includes those land areas that could potentially be affected by the resulting sonic boom. As shown in Figure 2-4, Mission A could affect the NWHI, while Mission B could affect Wake Island. These island areas are described below.

Northwestern Hawaiian Islands

The NWHI are a remote chain of atolls, islands, and shoals that stretch for more than 1,000 nmi (1,852 km) northwest of the main Hawaiian Islands. The NWHI—now part of the Papahānaumokuākea Marine National Monument, the largest marine conservation area in the world—contains abundant plant, bird, and marine life. The monument was established in 2006 by Presidential Proclamation 8031 to protect marine resources in the area, including coral reefs, the endangered Hawaiian monk seal, and various threatened and endangered sea turtle species. (71 FR 36443-36474; NOAA, 2009b)

The Proclamation requires that all activities and exercises of the Armed Forces must be carried out in a manner that avoids, to the extent practicable and consistent with operational requirements, adverse

impacts on the Papahānaumokuākea Marine National Monument resources and qualities. It also states that the prohibitions required by the Proclamation will not apply to those military activities and exercises that are consistent with applicable laws (71 FR 36443-36474). The proposed HTV-2 flight test over the monument would be consistent with these requirements; thus, the test activities would be exempt from the Proclamation's prohibitions.

Within the NWHI, the areas that could potentially be affected by the sonic boom are Maro Reef, Gardner Pinnacles, Brooks Banks, and French Frigate Shoals, which are all located in the central portion of the island chain. The only dry land in this area consists of small rocky pinnacles and numerous sand islands located mostly within the French Frigate Shoals. The Shoals is the most important breeding and nesting area for the green sea turtle in the entire Hawaiian archipelago. As much as 80 percent of all green sea turtles in the entire Hawaiian archipelago return to French Frigate Shoals to nest and breed. The majority of the world's population of Hawaiian monk seals is found in the NWHI where critical habitat has been designated. The French Frigate Shoals is one of several main breeding sites for Monk seals, and they have also been observed at Gardner Pinnacles and Maro Reef. The Shoals is also home to millions of migratory birds. On one island alone, an estimated 1.5 million Sooty Terns nest and breed. (NMFS, 2007; NOAA, 2009c)

Wake Island

Wake Atoll, which includes Wake Island, is a coral atoll located about 2,133 nmi (3,950 km) west of Hawaii. The "V" shaped atoll, consisting of three islands and a central lagoon, has approximately 2.85 square mi (7.38 square km) of dry land surrounded by a barrier reef. As previously described, Wake Island is an unorganized, unincorporated territory of the US administered by the US Department of the Interior. The airfield and support facilities, which are managed by the USAF, take up most of the land area. (MDA, 2007b)

Wake Island has a biologically diverse environment that includes insects, arthropods, small mammals, marine mammals, birds, and over 200 species of plants. More than 30 species of birds have been identified, including seabirds, shorebirds, and land birds. All seabirds present on the atoll, except for tropical species, are conspicuous nesters that lay their eggs in the open, either on bare ground or exposed in shrubs or small trees. Federal protection is provided for the migratory seabirds and for the few threatened and endangered species found on the atoll, including the Mariana crow, Mariana moorhen, and the Micronesian kingfisher. Green sea turtles have been observed in the near shore and lagoon waters, but no nesting activity has been confirmed. Hawksbill sea turtles also are suspected to occur at Wake Island, but there are no records or accounts of confirmed sightings. (MDA, 2007b)

3.3 US ARMY KWAJALEIN ATOLL/RONALD REAGAN BALLISTIC MISSILE DEFENSE TEST SITE AND THE MARSHALL ISLANDS

The RMI is located approximately 2,000 nmi (3,706 km) southwest of Hawaii (see Figure 2-4) and consists of approximately 1225 islands in 29 atolls scattered over 750,000 square mi (1,942,500 square km) (RMI Embassy, 2005). Centrally located within the RMI (see Figure 2-5), USAKA/RTS consists of all or portions of 11 out of 100 coral islands that enclose a large lagoon. Since the late 1950s, the Kwajalein Atoll has served as a primary site for testing ICBMs, sea-launched ballistic missiles, and antiballistic missiles.

Because of the Compact of Free Association between the RMI and the US, all US Government activities at USAKA/RTS must conform to specific compliance requirements, coordination procedures, and environmental standards identified in the UES. As specified in Section 2-2 of the UES, these standards also apply to all USAKA/RTS activities occurring elsewhere within the RMI, including the territorial

waters[5] of the RMI (USASMDC/ARSTRAT, 2006). Thus, all HTV-2 program actions proposed to occur at USAKA/RTS, at other RMI atolls, and within RMI territorial waters must comply with the UES.

Rationale for Environmental Resources Analyzed

For the proposed HTV-2 flight test activities within the Marshall Islands, noise, biological resources, and health and safety are the only resource areas analyzed. Water quality was also included in the analysis to account for potential impacts on marine life. Other resource topics were not analyzed further in this area because: (1) the Proposed Action does not require any new construction or extensive ground-disturbing activities, thus no impacts to soils would be expected; (2) mostly existing base personnel would be involved, thus, there are no socioeconomic concerns; (3) through avoidance of high altitude jet routes in the proposed BOA impact area (USASMDC/ARSTRAT, 2007) and the application of existing USAKA/RTS range safety procedures, there would be no major impacts on airspace; and (4) the Proposed Action is well within the limits of current operations at USAKA/RTS and it involves minimal activities at other RMI locations. As a result, there would be no adverse effects on land use, utilities, waste management, or transportation; and little or no impacts to air quality would occur.

3.3.1 NOISE

During terminal flight and impact in the BOA, the HTV-2 vehicle has the potential to affect land areas with sonic booms. Thus, the ROI for noise is focused primarily on those RMI atolls and islands closest to the HTV-2 flight paths. For the Mission A flight path, Bikar, Taka, and Utirik Atolls might be affected. For the Mission B flight path, Rongerik Atoll and possibly the eastern tip of Rongelap Atoll could be affected (see Figure 2-5). Not all of the atolls, however, are populated. Census records from 1999 show 19 residents on Rongelap Atoll, 433 residents on Utirik Atoll, and no populations on Bikar, Taka, or Rongerik Atolls (RMI Economic Policy, Planning, and Statistics Office [EPPSO], 2005).

Natural sources of noise on these remote atolls include the constant wave action along shorelines and the occasional thunderstorm. The sound of thunder, one of the loudest sounds expected here, can register up to 120 dB (Vavrek et al., 2008). Within the atoll communities, other sources of noise would include a limited number of motor vehicles, motorized equipment, and the occasional fixed-wing aircraft at the Rongelap and Utirik airfields. Typical daytime noise levels within the local communities are expected to range between 55 and 65 dBA (USASSDC, 1993).

3.3.2 BIOLOGICAL RESOURCES

The UES provides protection for a wide variety of marine mammals, sea turtles, fish, coral species, migratory birds, and other terrestrial and marine species, which are listed in Section 3-4 of the Standards (USASMDC/ARSTRAT, 2006). This protection applies to all of the following categories of biological resources occurring within the Marshall Islands, including RMI territorial waters:

- Any threatened or endangered species listed under the US Endangered Species Act (as amended)
- Any species proposed for designation, candidates for designation, or petitioned for designation to the endangered species list in accordance with the US Endangered Species Act (as amended)

[5] Territorial waters of the RMI are defined as the belt of ocean measured from the seaward low-water line of the RMI reef and extending seaward a distance of 12 nmi (22 km) (USASMDC/ARSTRAT, 2006).

- All species designated by the RMI under applicable RMI statutes, such as the RMI Endangered Species Act of 1975, Marine Mammal Protection Act of 1990, Marine Resources (*Trochus*) Act of 1983, and the Marine Resources Authority Act of 1989

- Marine mammals designated under the US Marine Mammal Protection Act of 1972

- Bird species pursuant to the Migratory Bird Conservation Act (MBCA)

- Species protected by the Convention on International Trade in Endangered Species, or mutually agreed on by USAKA/RTS, USFWS, NMFS, and the RMI Government as being designated as protected species. (USASMDC/ARSTRAT, 2006).

For purposes of this analysis, the ROI focused on: (1) the RMI atolls, islands, and BOA that could be affected by the HTV-2 sonic booms; and (2) the BOA where the HTV-2 vehicles would impact. The following subsections describe biological resources for marine and terrestrial environments within the ROI according to the environmental setting and the threatened, endangered, or other protected species that might be present.

3.3.2.1 Terrestrial (Atoll/Island) Environments

For terrestrial and reef-related biological resources, the ROI for the Mission A flight path includes Bikar, Taka, and Utirik Atolls. For the Mission B flight path, the ROI includes Rongelap and Rongerik Atolls (see Figure 2-5). A list of special status species potentially occurring in these areas is provided in Appendix C. Descriptions of each atoll are provided below.

Bikar Atoll

Bikar Atoll is a small, uninhabited atoll made up of seven islands with a total land area of approximately 0.19 square mi (0.49 square km) (RMI Embassy, 2005). There is a near continuous coral reef surrounding the atoll, with a narrow forked passage on the western side that makes boat access to the lagoon very difficult, particularly at ebb tide (United Nations Environment Programme–World Conservation Monitoring Centre [UNEP-WCMC], 1990).

The atoll has a unique arid ecosystem that is relatively undisturbed by invasive and exotic plant species. The main islands are partially forested with a dense, mixed growth of trees and shrubs. Nine plant species have been identified, including *Pisonia* and *Cocos* (coconut palm) trees. At least 18 bird species have been observed, including migratory sea and shore birds, and some tropical species (e.g., frigate birds, red-footed booby, brown noddy, and the red-tailed tropic bird). Numerous bird nests and small rookeries have also been noted on the islands. Green sea turtles are relatively abundant at the atoll, with signs of nesting activity greater here than on any other RMI atoll surveyed. In 1988, over 264 sets of nesting tracks were observed, along with numerous new and old nests. The reef and lagoon environments show a diverse fish population. Small clam and other bivalve species are noted as being abundant, including the top shell *Trochus*. (RMI Office of Environmental Planning and Policy Coordination [OEPPC], 2008; Thomas et al., 1989; UNEP-WCMC, 1990)

Because of its pristine environment and isolation, Bikar is one of several RMI atolls that have been nominated as a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site (UNESCO, 2009). Bikar Atoll has also been recommended for protection as a National Preserve (RMI OEPPC, 2008).

Rongelap Atoll

Rongelap Atoll is one of the larger atolls in the RMI, made up of 61 islands with a total land area of approximately 3.07 square mi (7.95 square km) (RMI Embassy, 2005). Along the surrounding reef, there are several passages for larger vessels to enter the central lagoon. As previously mentioned, the airfield on Rongelap Island also allows access to the area via fixed-wing aircraft.

Information on biological resources at Rongelap Atoll is very limited and based primarily on vegetation observations from the mid-late 1950s. In 1956, vegetation on the larger islands was described as being in generally poor condition, consisting of scrub, mixed forests, and some pure forests of *Pisonia* trees. Similarly, coconut palm plantations were found in generally poor condition. Speculations at the time were that the poor conditions were the result of radioactive fallout from a US nuclear test conducted at Bikini Atoll (located to the west) 2 years earlier. Based on later studies of neighboring Rongerik Atoll (located to the east), it is expected that ecological conditions on Rongelap have much improved since the 1950s (see discussion below on Rongerik). Wildlife information for Rongelap is very limited. Migratory sea birds are known to nest on the islands. It is expected that green sea turtle nesting occurs on some beaches as well. (Fosberg, 1990; RMI OEPPC, 2008)

Rongerik Atoll

Rongerik Atoll is a relatively small, uninhabited atoll made up of 14 islands with a total land area of approximately 0.65 square mi (1.68 square km) (RMI Embassy, 2005). Large breaks in the reef should allow easy passage for larger vessels into the central lagoon.

Similar to Rongelap Atoll, environmental damage occurred at Rongerik from radioactive fallout in 1954. Later studies on Rongerik identified 35 plant species with 26 being native and the remaining nonnative. Interior island areas were noted to contain high-quality *Pisonia* and *Pisonia*/*Cordia* forests and some coconut palm trees. Twelve kinds of sea and shore birds and other migrant species have been identified on Rongerik Atoll, including red-footed boobies, brown boobies, Pacific reef heron, and great crested terns. The presence of numerous bird nests and several colonies provide evidence of the importance of Rongerik Atoll as a bird breeding area. Green sea turtle nesting has been noted on some of the beaches. In the local waters, reef fish were abundant, including some species considered rare at other atolls. A few live giant clams have been observed. The reefs overall are well developed with good habitat diversity. (RMI OEPPC, 2008; Thomas et al., 1989)

Rongerik Atoll has been nominated as a UNESCO World Heritage Site, because of its vegetation associations, diverse reef communities, and other unique natural features (UNESCO, 2009). Rongerik Atoll has also been recommended for protection as a National Preserve (RMI OEPPC, 2008).

Taka Atoll

Taka Atoll is a small, uninhabited atoll made up of six islands with a total land area of approximately 0.22 square mi (0.57 square km) (RMI Embassy, 2005). The central lagoon is encircled by an extensive reef system, but one wide pass is suitable for larger vessels (Thomas et al., 1989).

The larger islands have scrubby forests and areas of dense mixed forests of *Pisonia* and other tree species. There is also a large abandoned coconut palm grove. A total of 23 plant species have been identified on Taka Atoll. Bird species diversity is relatively high; up to 19 species were identified during prior surveys, including red-footed boobies, brown boobies, sooty terns, crested terns, great frigate birds, brown noddies, and spotted sandpipers. Several nesting bird colonies were observed on the islands. Green sea turtle nesting is also evident, with a limited number of turtle tracks observed. Along the reef, fish

diversity is considered normal, but populations are high. Gastropod mollusks are abundant, including a limited number of top shell *Trochus*. Giant clams were observed, as well. (RMI OEPPC, 2008; Thomas et al., 1989)

Taka Atoll has been nominated as a UNESCO World Heritage Site, because of its diverse range of habitats, sea birds, and reef species, particularly giant clams (UNESCO, 2009). Taka Atoll has also been recommended for protection as a National Park (RMI OEPPC, 2008).

Utirik (Utdrik) Atoll

Utirik Atoll is a small atoll made up of 10 islands with a total land area of approximately 0.94 square mi (2.43 square km) (RMI Embassy, 2005). The central lagoon is encircled by an extensive reef system with limited access for vessels. The airfield on Utirik Island also allows access to the area via fixed-wing aircraft.

Information on biological resources at Utirik Atoll is very limited and based primarily on vegetation observations from the mid-late 1950s. Utirik has been populated for many years, and accordingly, is altered to a greater degree than the other northern RMI atolls. Like Rongelap and Rongerik Atolls, Utirik was also exposed to radioactive fallout in 1954. Nearly 50 plant species have been identified on Utirik including an increase in weed establishment. Much of the vegetation cover is native scrub forest, consisting of *Pisonia*, *Cordia*, and/or other tree and shrub species. Coconut palms are also common and widespread on several of the islands. Bird populations are not very prominent. Although no information was found that describes marine life at the atoll, it is expected that a variety of fish, coral, clams, and other marine invertebrates can be found in the local waters. (Fosberg, 1990; RMI OEPPC, 2008)

3.3.2.2 Broad Ocean Area Environment

For biological resources in the BOA, the ROI focuses on the deep ocean waters north of USAKA/RTS where the HTV-2 impacts would occur. The ROI also includes other international ocean areas and territorial waters of the RMI that might be affected by the HTV-2 sonic booms.

Ocean depths in this region of the RMI generally range between 6,560 and 16,400 ft (2000 and 5000 m) (Hein et al., 1999). Just as described for the open-ocean environment in Section 3.2.2.1, there is a wide variety of pelagic and benthic communities in the BOA. A number of threatened, endangered, and other protected species occur here, including whales, small cetaceans, and sea turtles. These are listed in Table 3-9 for the ROI. Some of these species occur only seasonally for breeding or because of unique migration patterns.

As described in Section 3.2.2.1, there are many different sources of noise in the marine environment, both natural and anthropogenic. Within the ROI, some of the loudest underwater sounds generated are most likely to originate from storms, ships, and some marine mammals.

3.3.3 HEALTH AND SAFETY

For the two HTV-2 flight tests, USAKA/RTS would provide range support for the terminal phase of each flight. At USAKA/RTS and at other locations within the RMI, there would be no requirements or issues related to launch safety, launch hazards, or rocket propellant handling. Thus, the ROI for health and safety focuses on the HTV-2 terminal flight paths and impact areas in the BOA north of USAKA/RTS, including consideration of military personnel, contractors, and the general public.

Table 3-9. Protected Marine Mammal and Sea Turtle Species Occurring within the Broad Ocean Area of the Marshall Islands		
Common Name	**Scientific Name**	**Status**
Marine Mammals		
Blue Whale	*Balaenoptera musculus*	E, MMPA
Finback Whale	*Balaenoptera physalus*	E, MMPA
Humpback Whale	*Megaptera novaengliae*	E, MMPA
Sperm Whale	*Physeter macrocephalus*	E, MMPA
Offshore Spotted Dolphin	*Stenella attenuata attenuata*	RS, MMPA
Coastal Spotted Dolphin	*Stenella attenuata graffmani*	RS, MMPA
Eastern Spinner Dolphin	*Stenella longirostris orientalis*	RS, MMPA
Whitebelly Spinner Dolphin	*Stenella longirostris longirostris*	RS, MMPA
Costa Rican Spinner Dolphin	*Stenella longirostris centroamericana*	RS, MMPA
Common Dolphin	*Delphinus delphis*	RS, MMPA
Striped Dolphin	*Stenella coeruleoalba*	RS, MMPA
Spinner Dolphin	*Stenella longirostris*	RS, MMPA
Pacific Bottlenose Dolphin	*Tursiops gilli*	RS, MMPA
Risso's Dolphin	*Grampus griseus*	RS, MMPA
Bottlenose Dolphin	*Tursiops sp.*	RS, MMPA
Pygmy Sperm Whale	*Kogia breviceps*	MMPA
False Killer Whale	*Pseudorca crassidens*	MMPA
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	MMPA
Melon Headed Whale	*Peponocephala electra*	MMPA
Pygmy Killer Whale	*Feresa attenuata*	MMPA
Killer Whale	*Orcinus orca*	MMPA
Blainville's Beaked Whale	*Mesoplodon densirostris*	MMPA
Sea Turtles		
Green Sea Turtle	*Chelonia mydas*	T, RS
Loggerhead Sea Turtle	*Caretta caretta*	T, RS
Olive Ridley Sea Turtle	*Lapidochelys olivacea*	T, RS
Leatherback Sea Turtle	*Dermochelys coriacea*	E, RS
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E, RS

Notes:

E = Endangered

T = Threatened

RS = Protected under RMI Statute

MMPA = Protected under the Marine Mammal Protection Act

Source: NOAA, 2009a; USASMDC/ARSTRAT, 2006.

USAKA/RTS has the unique mission of serving as the target area for a wide variety of missile launch operations from Vandenberg AFB, CA, and from the Pacific Missile Range Facility in Hawaii. These missions are conducted only with the approval of the USAKA/RTS Commander. A specific procedure is established to ensure that such approval is granted only when the safety requirements for proposed test activities have been adequately addressed.

All program operations must receive the approval of the Safety Office at USAKA/RTS. This step is accomplished through presentation of the proposed program to the Safety Office. All safety analyses,

standard operating procedures, and other safety documentation applicable to those operations affecting the USAKA/RTS must be provided, along with an overview of mission objectives, support requirements, and schedule. The Safety Office evaluates this information and ensures that all USAKA/RTS range safety requirements (including both ground and flight safety) and supporting regulations are followed. (USASMDC/ARSTRAT, 2007)

Range safety provides protection to USAKA/RTS personnel, inhabitants of the Marshall Islands, and ships and aircraft operating in areas potentially affected by missions. Specific procedures are required for the preparation and execution of missions involving aircraft, missile launches, and reentry payloads like the HTV-2. These procedures are based on regulations, directives, and flight safety plans for individual missions. The flight safety plans include evaluating risks to inhabitants and property near the flight path, calculating trajectory and debris areas, and specifying range clearance and notification procedures (USASMDC/ARSTRAT, 2007). Criteria used at USAKA/RTS to determine debris hazard risks are in accordance with RCC Standard 321-07, *Common Risk Criteria Standards for National Test Ranges* (RCC, 2007).

Inhabitants near the flight path, as well as international air and sea traffic in caution areas designated for specific missions, are notified of potentially hazardous operations. As described earlier for Vandenberg AFB, a NOTMAR and a NOTAM are transmitted to appropriate authorities to clear traffic from these caution areas and to inform the public of impending missions. The warning messages describe the time, the area affected, and safe alternate routes. The RMI is also informed in advance of rocket launches and reentry payload missions. USAKA/RTS radar and/or visual sweeps of hazard areas are accomplished immediately prior to operations to assist in the clearance of non-mission ships and aircraft. (USAF, 2004; USASMDC/ARSTRAT, 2007)

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences of the Proposed Action and No Action Alternative, described in Chapter 2.0 of this EA, when compared to the affected environment described in Chapter 3.0. The amount of detail presented in each section of the analysis is proportional to the potential for impact. Both *direct* and *indirect* impacts[6] are addressed where applicable. In addition, *cumulative* effects that might occur are identified in Section 4.3. Appropriate environmental management and monitoring actions and requirements are also included in this chapter, where necessary, and summarized in Section 4.4. A list of all agencies, organizations, and persons consulted as part of this analysis is provided in Chapter 6.0.

4.1 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

The following subsections describe the potential environmental consequences of implementing the Proposed Action at Vandenberg AFB, within the over-ocean flight corridor, and at USAKA/RTS and the Marshall Islands. Environmental issues associated with the proposed HTV-2 flight tests vary widely at each location, and as such, the resources analyzed at each location also vary. A breakdown of the resources analyzed in detail, by location, is shown in Table 4-1, along with the section numbers where the respective discussions are found.

Table 4-1. Resources Analyzed in Detail by Location

Location	Air Quality	Noise	Biological Resources	Cultural Resources	Health & Safety	Hazardous Materials & Waste Mgt
Vandenberg AFB	Sect. 4.1.1.1	Sect. 4.1.1.2	Sect. 4.1.1.3	Sect. 4.1.1.4	Sect. 4.1.1.5	Sect. 4.1.1.6
Over-Ocean Flight Corridor and the Global Environment	Sect. 4.1.2.1 [1]		Sect. 4.1.2.2			
USAKA/RTS and the Marshall Islands, including the BOA		Sect. 4.1.3.1	Sect. 4.1.3.2		Sect. 4.1.3.3	

[1] Air quality at this location focuses on the stratospheric ozone layer and GHS within the Global Atmosphere.

Various management controls and engineering systems are in place at Vandenberg AFB and at USAKA/RTS to manage and implement environmental and safety requirements. Required by Federal, state, DOD, and agency-specific regulations, these measures are implemented through normal operating procedures. To help ensure that procedures are followed, base personnel and contractors receive periodic training on applicable environmental and safety requirements. In addition, environmental audits by both internal offices and external agencies are conducted at the installations to verify compliance.

[6] *Direct* impacts are caused by the action and occur at the same time and place. *Indirect* impacts occur later in time or are further removed in distance, but are still reasonably foreseeable.

4.1.1 VANDENBERG AIR FORCE BASE

4.1.1.1 Air Quality

Although short-term minor adverse effects to air quality would be expected with the implementation of the Proposed Action, the overall impacts would be insignificant. The total direct and indirect emissions, however, would not exceed *de minimis* (minimal importance) thresholds, be regionally significant, or contribute to a violation of Vandenberg AFB's air operating permits.

The general conformity rules require Federal agencies to determine whether their action(s) would increase emissions of criteria pollutants above preset threshold levels (40 CFR 93.153). These *de minimis* rates vary depending on the severity of the nonattainment and geographic location. Because Santa Barbara County is an attainment area for all NAAQS, the general conformity rules do not apply (40 CFR 93; SBCAPCD Rule 702). For the purposes of this EA, however, these threshold levels were used to determine whether implementation of the Proposed Action would be significant under NEPA. The *de minimis* levels of 100 tons per year (tpy) for all criteria pollutants were used for comparison purposes.

The total direct and indirect emissions associated with the Proposed Action were estimated and would not exceed *de minimis* levels (Table 4-2). Because AQCR 032 and Santa Barbara County are an attainment area, there are no existing emission budgets. Due to the limited size and scope of the Proposed Action, it is not anticipated that the estimated emission would make up 10 percent or more of regional emissions for any criteria pollutant and be regionally significant. Detailed methodologies for estimating the air emissions are described in Appendix D.

Table 4-2. Estimated Emissions of Criteria Pollutants for the Proposed Action (Tons per Year)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Site Modifications	0.20	0.28	0.05	0.000	0.01	0.01
Pre-Launch Preparations and Rocket Motor Transportation	1.28	0.31	0.14	0.001	0.02	0.01
Launch Activities[1]	39.30	0.03	0.00	0.003	12.31	8.60
Post-Launch Operations	0.14	0.02	0.11	0.000	0.00	0.00
Total	**40.92**	**0.64**	**0.31**	**0.005**	**12.34**	**8.62**
De Minimis Thresholds (tpy)	100	100	100	100	100	100
Exceeds *De Minimis* Threshold	**No**	**No**	**No**	**No**	**No**	**No**

[1] PM_{10} emissions from launch vehicle exhaust are assumed to be 10.3 percent total aluminum oxide (Al_2O_3), while $PM_{2.5}$ emissions are assumed to be 7.2 percent total Al_2O_3 (USAF, 2004).

4.1.1.1.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Site modifications would be minor and limited to just the IRF (Building 1900). Modifications to existing facilities would not include any clearing, grading, or open burning. No fugitive dust emissions are expected. For the site modifications, pre-launch preparations, and local rocket motor transportation emissions shown in Table 4-2, all of the sources listed below were estimated for direct and indirect emissions of criteria pollutants. Detailed methodologies for estimating the air emissions are provided in Appendix D.

- Combustive emissions from equipment used for Building 1900 modifications
- Painting/corrosion control efforts from refurbishing activities at Building 1900
- Emissions from delivery of equipment, supplies, and services
- Employee commuting during facility modifications and pre-launch activities
- Emissions from transporting booster motors, components, and equipment to Vandenberg AFB
- Emissions from transporting the HTV-2 vehicles and equipment to the launch site
- Use of solvent/paints/adhesives during launch vehicle integration

Proper tuning and preventive maintenance of vehicles and other support equipment would minimize engine exhaust emissions. In addition, site modifications and pre-launch preparations for the HTV-2 flights would be conducted in compliance with all applicable SBCAPCD rules and regulations, including those that cover the use of organic solvents (Rule 317), architectural coatings (Rule 323), surface coating of metal parts and products (Rule 330), surface coating of aircraft or aerospace parts and products (Rule 337), or adhesives and sealants (Rule 353) (SBCAPCD, 2009b). No hazardous liquid propellants, such as hydrazine, would be used as part of the Proposed Action. At SLC-8, an emergency power portable generator provided by the launch contractor would be permitted by the SBCAPCD or registered under the CARB Portable Equipment Registration Program.

As a result, the proposed site modifications, pre-launch preparations, and rocket motor transportation requirements would not cause significant impacts on local or regional air quality.

4.1.1.1.2 Launch Activities

Under the Proposed Action, both flight tests may be conducted within the same year. Therefore, two launches per year were carried forward as a worst-case condition for analysis purposes. In the hours before launch, remote sensors and helicopters (when available) may be used to verify that the hazard areas would be clear of non-mission-essential aircraft, vessels, and personnel. All direct and indirect emissions of criteria pollutants for the helicopter exhaust emissions and from the HTV-2 flight tests were estimated (Table 4-2). In addition to criteria pollutants, the products of combustion from the Minotaur IV Lite booster would also include other common products of combustion including aluminum oxide, hydrogen chloride, hydrogen, nitrogen, carbon dioxide, and water. Table 4-3 provides a comprehensive breakdown of the booster emissions for two launches. Detailed methodologies for estimating air emissions during launch are provided in Appendix D.

During boost flight, the rocket emissions from all stages would be rapidly dispersed over a large geographic area and by prevailing winds. Because the launches would be short-term, discrete events, the time between launches allows the dispersion of the emission products. The emissions per launch at Vandenberg AFB would be the same for each launch vehicle, but the atmospheric concentrations would differ depending on local meteorological conditions at the time of launch, such as temperature profiles, atmospheric stability, wind speeds, and the presence or absence of inversions. No exceedance, however, of air quality standards or health-based standards for non-criteria pollutants would be anticipated. Launch activities would be conducted in compliance with all applicable SBCAPCD rules and regulations. As a result, no significant impacts on local or regional air quality are expected.

4.1.1.1.3 Post-Launch Operations

In the hours and days following the launch, a general safety check and cleanup of the launch site would occur. All direct and indirect emissions of criteria pollutants for worker commuting, the removal of

Table 4-3. Exhaust Emissions from Two Minotaur IV Lite Booster Launches (Tons)				
Pollutant	**1st Stage**	**2nd Stage**	**3rd Stage**	**Total**
Aluminum Oxide (solid) (Al_2O_3)	35.34	19.43	5.01	**59.77**
Carbon Monoxide (CO)	21.79	11.98	5.52	**39.29**
Carbon Dioxide (CO_2)	2.40	1.32	0.26	**3.98**
Hydrogen Chloride (HCl)	20.88	11.48	0.24	**32.61**
Water (H_2O)	7.34	4.03	0.51	**11.88**
Hydrogen (H_2)	2.20	1.21	0.35	**3.75**
Nitrogen (N_2)	8.25	4.54	3.77	**16.56**
Other miscellaneous	0.27	0.15	0.00	**0.41**

Source: SMC Det 12/RPD, 2005.

equipment from the launch site, and general refurbishment of the launch facility were estimated (see Table 4-2). Detailed methodologies for estimating air emissions for post-launch activities are provided in Appendix D. Post-launch refurbishment activities would comply with all applicable SBCAPCD rules and regulations, including Rule 323 (architectural coatings) for VOCs found in paints (SBCAPCD, 2009b). No new air emission permits would be required for these operations. With the exception of minor, localized increases in particulate matter from the brushing of blast residues from the launch stool, no significant impacts on local or regional air quality are expected.

4.1.1.2 Noise

4.1.1.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Noise exposures from proposed modification activities on base are expected to be minimal and short term. Most of the site modification noise would occur at the IRF (Building 1900). The use of trucks, power tools, compressors, and other machinery would be expected to produce noise levels ranging from 85 to 104 dBA at close range (Suter, 2002).

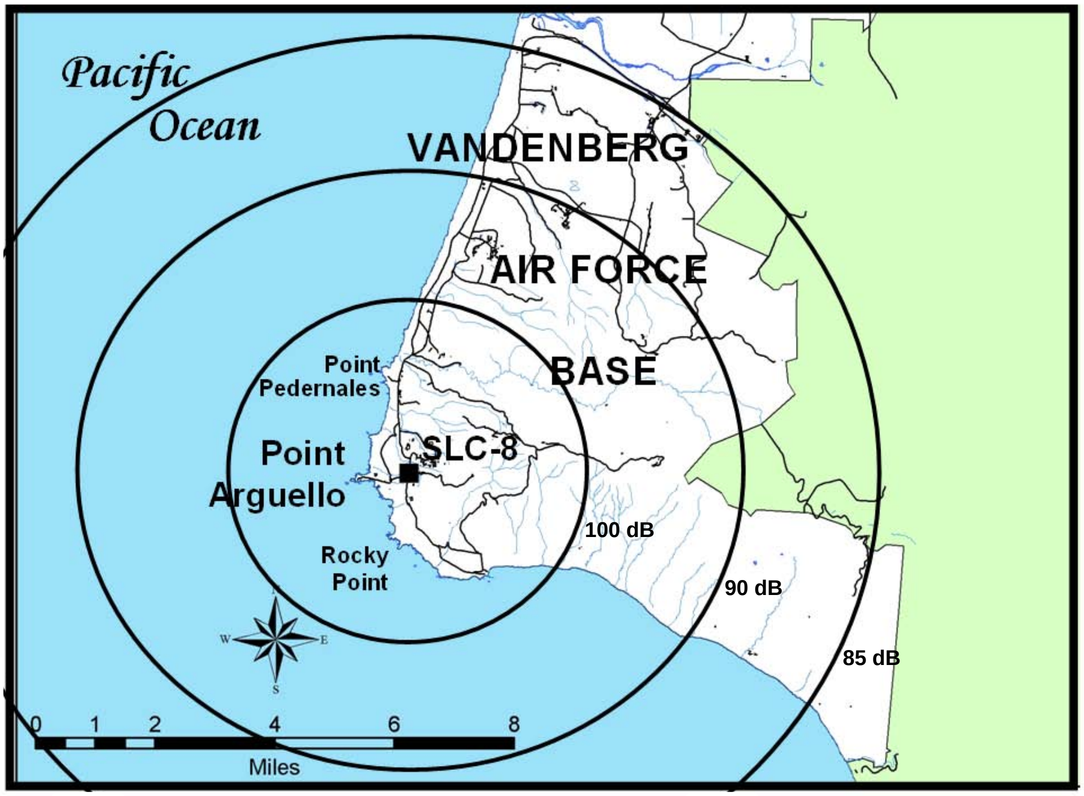
The noise generated during pre-launch preparations would come primarily from the use of trucks, cranes, and other load handling equipment. Noise levels from such operations would be expected to range between 84 and 100 dBA in the immediate area surrounding the activities at SLC-8 and at other support facilities (Suter, 2002).

For all of these actions, noise exposure levels would comply with USAF Hearing Conservation Program requirements (as described in Section 3.1.2) and other applicable occupational health and safety regulations. Because most of the activities would take place on base, the public in the surrounding communities would not detect an increase in noise levels.

As a result, the proposed site modifications, pre-launch preparations, and rocket motor transportation requirements would not cause significant noise impacts.

4.1.1.2.2 Launch Activities

Noise levels generated by each HTV-2 program launch would vary, depending on the launch trajectory used and the weather conditions during launch. At a distance of 1,000 ft (305 m) from the SLC-8 launch pad, the launch noise would be approximately 131 dB ASEL (Do, 1994). With increasing distance, the ASEL generated would decrease to around 85 dB nearly 8 mi (13 km) away. Figure 4-1 depicts the



Source: USAF, 2006

Figure 4-1. Predicted A-Weighted Sound Exposure Levels for Minotaur IV Lite Launches from Vandenberg AFB, CA

predicted maximum noise-level contours for proposed Minotaur IV Lite vehicle launches from SLC-8. The modeling results depicted in the figure represents a maximum predicted scenario that does not account for variations in weather or terrain. Based on the modeling results, the City of Lompoc and other communities off base would be outside the 85-dBA noise contour.

While these noise exposure levels can be characterized as very loud in some areas, they would occur infrequently, are very short in duration (about 20 seconds of intense sound per launch), and have little effect on the CNEL in these areas. Personnel working near the area at the time of launch would be required to wear adequate hearing protection in accordance with USAF Hearing Conservation Program requirements. If helicopters are used to verify that beach areas and near shore waters are clear of non-participants, then they would generally limit their flights to the areas around the base, thus also limiting the noise effects on local communities.

The sonic boom generated by the Minotaur IV Lite launch vehicle would occur down range, well off the CA Coast. Flight trajectories would be in a westerly direction (Figure 2-3), and as such, the resulting sonic boom would be inaudible over coastal areas, including the northern Channel Islands. Although sonic boom data for the Minotaur IV Lite vehicle is unavailable, it is expected that the resulting overpressures would be considerably less than the 7.2 psf expected from the much larger Atlas V system launched from South Vandenberg (USAF, 2000). Typically, the sonic boom would last no more than a few hundred milliseconds.

As a result, no significant impacts on the human environment are expected from launch noise or sonic booms. For discussions of potential impacts on protected wildlife species, refer to Sections 4.1.1.3 and 4.1.2.2.

4.1.1.2.3 Post-Launch Operations

Noise levels generated during post-launch operations would be similar to those generated during pre-launch preparations, but for a shorter duration. Thus, no impacts to ambient noise levels are expected.

4.1.1.3 Biological Resources

4.1.1.3.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

At Vandenberg AFB, site modifications and pre-launch preparations are expected to produce noise levels ranging from 84 to 104 dBA near the activities (see Section 4.1.1.2.1). These activities would be relatively short-term and intermittent, and the vehicles and other equipment used would normally remain on paved or gravel areas.

Overall, it is expected that these activities would not have significant impacts on local vegetation and wildlife, because: (1) noise exposures from these activities generally would be short-term and localized around existing facilities and along roadways; and (2) no soil or vegetation disturbance is expected to occur. For these same reasons, the proposed activities would not have significant impacts on threatened or endangered species (e.g., Gaviota tarplant and the California red-legged frog) or other sensitive habitats.

4.1.1.3.2 Launch Activities

Potential issues associated with the HTV-2 program launches at Vandenberg AFB include wildlife responses to helicopter overflights (if conducted), wildlife responses and potential injury from excessive launch noise, and the release of potentially harmful chemicals in the form of exhaust emissions. The release of unburned propellant from a possible launch failure or termination is also considered. The potential effects of these actions on the biological resources at Vandenberg AFB are described in the paragraphs that follow.

Vegetation

Although heat and emissions from rocket exhaust can sometimes result in localized foliar scorching and spotting, such effects from larger launch systems have been shown to be temporary and not of sufficient intensity to cause significant, long-term damage to vegetation (National Aeronautics and Space Administration [NASA], 2002; USAF, 2000). As previously mentioned, the vegetated areas immediately around the SLC-8 launch site are maintained to minimize the risk of brush fires. During launch operations, emergency firefighting personnel and equipment would also be on standby status as a protective measure in case of brush fires.

Wildlife

<u>Helicopter Overflights.</u> When available, base helicopters might be flown over the ROI on the day of launch and possibly the day before to ensure launch hazard areas are clear of unauthorized personnel. Helicopter overflights have the potential to disturb marine mammals and birds, causing separation of pinniped mothers from their offspring; potential loss of eggs when birds fly from nests; and abandonment of favored resting, feeding, or breeding areas.

Under the terms of the MMPA, as amended, short-term behavioral effects on marine mammals are considered. According to the MMPA, "harassment" means any act of "pursuit, torment, or annoyance" that has the potential to injure or disturb marine mammals or marine mammal stock.[7] Proposed HTV-2 program launches and other system launches at Vandenberg AFB have the potential to harass marine mammals. To address this issue, base personnel consulted the NMFS to obtain a programmatic "take" permit to allow Level B Harassment on four pinniped species, including the California sea lion, Pacific harbor seal, and the northern elephant seal. A 5-year take permit was originally issued to Vandenberg AFB in 1997, and was later re-issued in February 2004 and again in February 2009. Under the permit, the NMFS is allowed to issue annual Letters of Authorization (LOAs) to Vandenberg AFB for these harassments, which are classified as a small number of "takes" incidental to space vehicle and test flight activities. The programmatic take permit and LOAs allow the base to expose pinnipeds, including breeding harbor seals, to missile and rocket launches, and aircraft flight tests. They also authorize incidental harassment of pinnipeds from helicopter overflights. (74 FR 6236-6244; USAF, 1997)

Prior observations of helicopter overflights in launch hazard areas have shown them to be a greater source of disturbance than the rocket launches (Bowles, 2000). Under the current NMFS permit and LOA, helicopters and other aircraft are required to maintain a minimum slant range of 1,000 ft (305 m) year round from recognized seal haul-outs and rookeries, including the shoreline areas between Point Pedernales and Oil Well Canyon just east of Rocky Point (see Figure 3-3) (74 FR 6236-6244; VAFB, 2007a). These requirements can be modified only in emergencies, such as during search-and-rescue and firefighting operations. When helicopter flight restrictions are observed, there are negligible impacts on marine mammals and other wildlife.

<u>Launch Noise.</u> As previously analyzed in the OSP EA (USAF, 2006), noise generated by Minotaur IV launches from SLC-8 may result in the incidental harassment of pinnipeds along the base shoreline. Because the flight trajectories would be in a westerly direction (Figure 2-3), the resulting sonic boom would not affect seals, sea lions, and other pinnipeds located in the northern Channel Islands. To confirm that no monitoring of pinnipeds on San Miguel Island would be needed during the launches, Vandenberg AFB personnel coordinated with NMFS. In an electronic response to Vandenberg AFB (dated November 6, 2008), the NMFS agreed that monitoring on San Miguel Island is not required (see Appendix A, page A-18).

On base, the noise and visual disturbances from launches may cause pinnipeds to move towards or enter the water. Field surveys have shown that the louder the launch noise, the longer it took for seals to begin returning to the haul-out site and for the numbers to return to pre-launch levels. Seals may begin to return to the haul-out site within 2 to 55 minutes of the launch disturbance, and pre-launch population levels at the haul-out site were usually restored within 45 to 120 minutes after launch. No evidence of injury, mortality, or abnormal behavior has been observed for Pacific harbor seals following a launch from Vandenberg AFB. Additionally, research has shown that population levels at the pinniped haul-out sites have remained constant. (69 FR 5720-5728; SRS Technologies [SRS], 2000, 2001a)

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[7] Under the MMPA, two categories of harassment are defined: (a) the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment), and (b) disturbance to a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns, e.g., migration, breathing, nursing, breeding, or feeding (Level B harassment). Prior rulings by NMFS, however, have determined that a momentary behavioral reaction of a protected marine mammal to an acoustic event that is both brief and isolated in time does not qualify as Level B harassment (US Department of the Navy [USN], 2008b). In addition, Section 319 of the National Defense Authorization Act of 2004 (Public Law 108-136) revised the definition of "harassment" in the MMPA (16 USC 1362(18)) as it applies to military readiness activities. Under the revised definitions, "Level A harassment" is "any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered."

To minimize potential long-term effects of launch noise on pinnipeds, the programmatic take permit requires several measures, including: (1) schedule missions, whenever possible, to avoid launches during the harbor seal pupping season (March 1 through June 30), unless constrained by factors including, but not limited to, human safety, national security, or for a space vehicle launch trajectory necessary to meet mission objectives; (2) conduct biological monitoring for all launches during the harbor seal pupping season in accordance with permit procedures, and report the results to the NMFS; and (3) conduct both acoustic and biological monitoring for all new space and missile launch vehicles during at least the first launch (including an existing vehicle from a new launch site), whether it occurs within the pupping season or not (74 FR 6236-6244). The proposed HTV-2 program launches would be conducted in accordance with the measures specified in the programmatic take permit.

The marine mammal programmatic take permit covers a forecast of up to 30 space and missile launches per year at Vandenberg AFB (74 FR 6236-6244). The addition of two HTV-2 program launches within a year would not cause the forecast limit to be exceeded (refer to Section 4.3.1 for further discussions on this issue).

As for other non-listed species at Vandenberg AFB, any terrestrial mammals or birds in proximity to a launch might suffer startle responses and flee the area for a short period of time. These effects, however, would be temporary and are not expected to affect local population levels.

Because of the programmatic take permit measures already in place, and considering that only two HTV-2 program launches are planned, no significant impacts to pinnipeds or to other non-listed wildlife species on base are expected to occur as a result of launch noise.

<u>Launch Emissions and Plume Effects.</u> The atmospheric deposition of launch emissions has the potential to acidify surface waters. The types and quantities of emissions products released from the Minotaur IV Lite booster are listed in Table 4-3. The principal combustion product of concern is HCl gas, which forms hydrochloric acid when combined with water.

The acidification of surface waters in small drainages and in the wastewater retention ponds near SLC-8 could present harmful conditions for aquatic wildlife and nearby protected species. The bedrock and, by inference, the soils at Vandenberg AFB do not contain large amounts of acid-neutralizing minerals. The proximity of the proposed launch sites to the ocean combined with the prevailing onshore winds, however, causes the deposition of acid-neutralizing sea salt. The alkalinity derived from sea salt should neutralize the acid falling on soil, thus eliminating the potential for acid runoff. Surface water monitoring conducted for larger launch systems on Vandenberg's South Base has not shown long-term acidification of surface waters (USAF, 2000).

<u>Launch Failure or Early Flight Termination.</u> In the unlikely event of a failure during launch, or an early termination of flight, the launch vehicle would most likely fall into the ocean reasonably intact, along with some scattered debris. Fragments of unburned solid propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be widely dispersed. Of particular concern is the ammonium perchlorate in the solid propellant resin binding-agent. Once the propellant enters the water, the ammonium perchlorate could slowly leach out and create toxic conditions for plants and animals. Laboratory studies, however, have shown that in freshwater at 68° F (20° C), the leaching of all perchlorate from solid propellant fragments can take many years, depending on the fragment weight (Lang et al., 2003). In lower water temperatures and/or in more saline (ocean) waters, perchlorate leaching rates become even slower (Lang et al., 2002).

A lesser hazard may also exist from small amounts of battery electrolyte carried on each launch vehicle. The risks from electrolytes are far smaller than for propellants because of smaller quantities and the use of more rugged containment systems for batteries (NASA, 2002).

The probability of an aborted launch for a Minotaur IV Lite vehicle is very low. Historically, launch records indicate a 4 percent failure rate for similar Peacekeeper ICBM launch vehicles (SMC Det 12/RPD, 2006). Because of newer technologies and system innovations, the failure rate for a Minotaur IV Lite should be even less. If an early abort were to occur, then base actions would be taken immediately for the recovery and cleanup of unburned propellants and any other hazardous materials that had fallen on the beach, off the beach within 6 ft (1.8 m) of water, or in any freshwater creeks, retention ponds, and wetland areas. Recovery from deeper coastal waters would occur on a case-by-case basis. Because any solid propellants or flight batteries remaining in the offshore waters would be subject to constant wave action and currents, localized build-up of perchlorate concentrations or other contaminants is unlikely to occur.

As a result, launch-related activities are not expected to have a significant impact on wildlife.

Threatened and Endangered Species

Those threatened and endangered species that could be potentially affected by the HTV-2 program launches at Vandenberg AFB are listed in Table 3-5 and discussed in the paragraphs that follow. Although other listed species occur on Vandenberg AFB, their remoteness from the launch sites makes it unlikely that they would be adversely affected.

The only listed plant species that could be potentially affected are the Federally endangered Gaviota tarplant and the state-threatened surf thistle, both of which are located at least 0.8 mi (1.3 km) from the SLC-8 launch pad. At this distance, there is very little risk for plants to be affected by the solid rocket motor emissions, including HCl deposition. Immediately following launch, the emissions would be rapidly dispersed and diluted over a large area. Following their recent review, Vandenberg AFB biologists also concluded that the HTV-2 launches would have “no effect” on Gaviota tarplant (Evans, 2009).

The Federally threatened California red-legged frog is commonly found in freshwater areas on base, including the wastewater retention ponds near SLC-8. Because the ponds are approximately 1,310 ft (400 m) from the SLC-8 launch area, the frogs could be exposed to high launch noise levels (around 129 dB ASEL [Do, 1994]) and some acidic exhaust products from the rocket motor. It is expected, however, that during a launch, the red-legged frogs would dive underwater, where they would be less susceptible to acoustic effects because the sound levels would be attenuated to some degree. Additionally, the constant deposition of wind-blown sea salt should eliminate the potential for water acidification. Giving support to these conclusions, previous monitoring studies conducted at the wastewater ponds for an Athena 2 launch from SLC-6 (located just north of SLC-8) showed no reduction in the number of red-legged frogs, no change in water pH levels, and no change in the acid neutralizing capacity of the water (USFWS, 1999). Following their recent review, Vandenberg AFB biologists concluded that the HTV-2 launches “may effect” red-legged frogs; however, the effects are permitted under the existing biological opinion issued earlier by the USFWS for SLC-8 (Evans, 2009). The biological opinion authorizes the incidental harassment of an unspecified number of the frogs as a result of rocket launches (USFWS, 1999).

The sights and sounds of the Minotaur IV Lite launches and possible helicopter overflights could affect some of the threatened and endangered bird species found at Vandenberg AFB. Endangered California brown pelicans roost at several shoreline locations near SLC-8, the closest being Point Arguello and Rocky Point, each approximately 1 mi (1.6 km) away (see Figure 3-3). At this distance, the launch would

expose the brown pelicans to ASEL levels near 115 dB (USAF, 2006). Such sound levels and sight of the launch vehicle may cause a temporary startle and flush response in brown pelicans roosting in the vicinity. Monitoring studies conducted for a 2001 Atlas IIAS launch, however, showed no evidence of injury, mortality, or abnormal behavior in brown pelicans (SRS, 2001b). Similarly, for an earlier Delta II mission, no differences in brown pelican roosting patterns were observed in the days prior to launch as compared to after the launch (SRS, 2001a). To minimize potential impacts on seabirds from security helicopter overflights, the helicopters and other aircraft are required to maintain a minimum slant range of 1,000 ft (305 m) year round from shoreline areas between Point Pedernales and Oil Well Canyon just east of Rocky Point (VAFB, 2007a).

Along Surf Beach, western snowy plovers forage year round and nest from early March through September within 3.9 mi (6.2 km) of the SLC-8 launch site. At this distance, the plovers would be subject to brief launch noise ASEL levels up to 93 dB (USAF, 2006). Launch noise and the flash of the rocket engine, especially at night, could cause a temporary startle and flush response in plovers. However, observations of flocks of snowy plovers during an Atlas IIAS launch from Vandenberg's SLC-3 launch pad in 2001 showed no interruption of activities, or any evidence of abnormal behavior or injury (SRS, 2001b). In addition, the sights and sounds of Minotaur IV Lite launches would be less than that of the much larger Atlas V and Delta IV vehicles that are currently launched from South Vandenberg (USAF, 2000).

As previously described, southern sea otter colonies are found in the offshore waters along the South Vandenberg coastline, within 2 mi (3.2 km) of SLC-8. At this distance, the animals could be exposed to surface launch noise just over 100 dB ASEL (USAF, 2006). Such events might cause the animals to suffer startle responses and retreat underwater temporarily. At such sound pressure levels, however, it is unlikely that the animals would experience any physiological effects, particularly when submerged. Monitoring of sea otters for an earlier Delta II launch showed no evidence of injury, mortality, mother-pup separation, or other abnormal behavior, even when exposed to launch noise ASEL levels of approximately 115 dB (SRS, 2001a). Any helicopter overflights near the otters could also startle the animals, but again, the effects would be temporary.

Following their recent review, Vandenberg AFB biologists concluded that the HTV-2 launches "may effect" California brown pelicans, California snowy plovers, and Souther sea otters; however, the effects are permitted under the existing biological opinion issued earlier by the USFWS for SLC-8 (Evans, 2009). The biological opinion authorizes the incidental harassment of an unspecified number of these species as a result of rocket launches (USFWS, 1995).

To minimize potential long-term impacts on red-legged frogs, brown pelicans, snowy plovers, and sea otters, monitoring requirements would be implemented for HTV-2 program launches at SLC-8 in accordance with the existing USFWS biological opinions listed below:

- *Biological Opinion for the California Spaceport, Vandenberg Air Force Base, Santa Barbara County, California* (USFWS, 1995)

- *Biological Opinion for the Spaceport Launch Program, Vandenberg Air Force Base, Santa Barbara County, California* (USFWS, 1999).

In summary, the proposed HTV-2 program launches and operations may cause short-term effects on some Federal and state threatened or endangered species. These actions, however, are not likely to adversely affect the long-term well being or survival of any of these species, thus no significant impacts are expected. The measures and monitoring requirements already in place at Vandenberg AFB would be incorporated into HTV-2 program launch operations to minimize potential impacts on listed species.

Environmentally Sensitive Habitats

Known habitat areas for the Gaviota tarplant and other protected plant species would not be adversely affected by normal launch operations from SLC-8. In the rare case of a launch anomaly where debris impacts near or within habitat areas, base biologists would assist in recovery operations by surveying the impact area to avoid or minimize damage to protected plant species. Emergency firefighting personnel and equipment would also be on standby status as a protective measure in case of brush fires.

Western snowy plover nesting habitat is located along Surf Beach on South Vandenberg within 3.9 mi (6.2 km) of the SLC-8 launch pad (see Figure 3-3). Launch noise here could reach 93 dB ASEL, but the habitat area would not be adversely affected by launches. No launch debris would impact the area.

Launches from SLC-8 would travel directly over the southern end of the Vandenberg SMR, resulting in noise levels ranging up to 110 dB ASEL over the near shore reserve waters (USAF, 2006). Such brief noise levels, however, are not expected to cause behavioral changes in the wildlife found in these waters. During a nominal flight, no launch debris would be expected to impact within the area.

Per earlier discussions, rocket launch emissions would not impact the water quality of local surface waters. If a launch anomaly were to occur, then actions at Vandenberg AFB would be taken immediately for the recovery and cleanup of unburned propellants, and any other hazardous materials that had fallen on the ground or in any of the freshwater creeks, retention ponds, wetlands, and shoreline areas. Recovery operations in deeper coastal waters, however, would be treated on a case-by-case basis. As a result, no significant impacts to terrestrial/freshwater habitats, the Vandenberg SMR, or to local essential fish habitat areas would occur.

4.1.1.3.3 Post-Launch Operations

The intermittent movement of trucks, cranes, and any clean-up/maintenance equipment would not produce substantial levels of noise, and vehicles would normally remain on paved or gravel areas. Thus, the limited actions associated with post-launch operations would have no significant impacts on local vegetation or wildlife, including threatened and endangered species, and other environmentally sensitive habitats.

4.1.1.4 Cultural Resources

4.1.1.4.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

Archaeological Sites

The HTV-2 program-related site modifications proposed at Vandenberg AFB would not require any excavation or other ground disturbance activities. The IRF (Building 1900) is the only building requiring modifications, and there are no known archaeological sites in the vicinity of the building.

Proposed rocket motor off-loading activities would occur at the Rail Transfer Facility (Facility 1886), which is located near an archaeological site. Unauthorized artifact collection by program personnel has the potential to adversely affect nearby archaeological sites. Personnel would not be notified of the location of nearby sites unless the sites are to be specifically avoided by HTV-2 program activities. The base Environmental Office would brief personnel, as necessary, on the sensitivity of cultural resources, applicable Federal regulations, and the mitigation measures that might be required if sites are

inadvertently damaged or destroyed. Thus, no significant or other adverse impacts to archaeological sites are expected.

The Minotaur IV Lite vehicle integration and launch site preparations represent routine types of activities at the base. In some situations, transportation activities could potentially harm subsurface resources when moving launch vehicle components and equipment to and from the launch pad and other facilities. So as not to risk disturbing archaeological sites, transport vehicles, cranes, and other load-handling equipment would remain on paved or gravel areas (no off-road travel).

Historic Buildings and Structures

Two facilities that would potentially be used for the HTV-2 program have been determined to be eligible for listing on the NRHP for their Cold War, ICBM Program historic context: the IRF (Building 1900) and the Rail Transfer Facility (Facility 1886). Of these, only the IRF would be modified in support of HTV-2 activities. The modifications to the IRF would include installation of lightning protection, adding fall protection to the roof, and changing the ordnance grounding points. All of these modifications are routine upgrades that are allowable under the existing Cold War Programmatic Agreement between Vandenberg AFB and the California SHPO (VAFB, 2002), and they do not affect the historic fabric of the IRF. Additionally, the IRF was included in HAER documentation related to the beddown of the GMD system (US Army Corps of Engineers, 2003) at Vandenberg AFB. The completed HAER could be considered mitigation for these minor upgrades as well. The existing HAER, and reuse of the building for HTV-2 activities that are similar to its original Peacekeeper mission, would further mitigate any impacts from the proposed modifications. Thus, no significant impacts to the IRF or any other historic structures are expected.

4.1.1.4.2 Launch Activities

No ground disturbance or other facility modifications would occur during flight activities. Thus, no significant or other adverse impacts to archaeological sites or historic buildings/structures are expected from nominal flight activities.

Falling debris from a flight termination or other launch anomaly, however, could strike areas on the ground where surface or subsurface archaeological deposits or other cultural resources are located. Such an impact could result in soil contamination, fire, and/or resource damage—all of which requires a reparation effort. Firefighting activities could damage subsurface historic and prehistoric archaeological sites as well. In the unlikely event that a mishap occurs, post-mishap recommendations would include post-event surveying, mapping, photography, and site recordation to determine and record the extent of the damage. These efforts would be coordinated with applicable range representatives and the California SHPO to develop the most appropriate mitigation measures based on the nature of the mishap and the cultural resources involved. Any debris falling offshore would not pose a threat to cultural resources on base.

4.1.1.4.3 Post-Launch Operations

Because of the limited activities associated with post-launch operations, no ground disturbance or other facility modifications would occur. However, because HTV-2 program personnel would be on site during cleanup and site maintenance, the potential for unauthorized artifact collection still exists. Personnel would be reminded of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed. Thus, no significant or other adverse impacts to archaeological sites or historic buildings/structures are expected to occur.

4.1.1.5 Health and Safety

4.1.1.5.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

For the proposed facility modification activities at Vandenberg AFB, all program personnel would be required to comply with applicable AFOSH and OSHA regulations and standards.

The launch vehicle integration and launch site preparations for the HTV-2 program represent routine types of activities at the base. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations within 29 CFR, would be followed, as well as all appropriate DOD and USAF regulations. The handling of large rocket motors and other vehicle ordnance is a hazardous operation that requires special care and training of personnel. By adhering to the established and proven safety standards and procedures identified in Section 3.1.5 of this EA, the level of risk to base personnel and the general public would be minimal.

The systems to be used for transportation of the Minotaur IV Lite rocket motors and related ordnance to Vandenberg AFB would provide environmental protection and physical security to the components. Heavily constructed trailers, carriages, and/or containers would be used to safely transport the motors. All transportation and handling requirements for the rocket motors and other ordnance would be accomplished in accordance with DOD, USAF, and DOT policies and regulations to safeguard the materials from fire or other mishap. As described in Section 3.1.5, accident rates for operations involving rocket motor transportation have been historically very low.

Pre-launch ground tests of the telemetry and tracking systems used on the HTV-2 vehicle and Minotaur IV Lite booster would comply with AFOSH Standard 48-9 (*Radio Frequency Radiation Safety Program*) for limiting potential human exposure to non-ionizing (radio frequency) radiation.

As a result, the proposed site modifications, pre-launch preparations, and rocket motor transportation requirements would not cause significant impacts on health and safety.

4.1.1.5.2 Launch Activities

Adherence to the policies and procedures identified in Section 3.1.5 protects the health and safety of on-site personnel. During launches, public safety and health are ensured through the establishment of Launch Hazard Areas, impact debris corridors, beach and access road closures (as necessary), and the coordination and monitoring of train traffic passing through the base, in addition to the NOTMARs and NOTAMs published for mariners and pilots. In support of each mission, a safety analysis would be conducted prior to launch activities to identify and evaluate potential hazards and reduce the associated risks to a level acceptable to Range Safety. For each rocket launch from Vandenberg AFB, the allowable public risk limit for launch-related debris is extremely low, as the following RCC Standard 321-07 criteria show:

- Individuals within the general public must not be exposed to a probability of casualty greater than 1 in 1,000,000 for any single mission. Collective risk for the general public (i.e., the combined risk to all individuals exposed to the hazard) must not exceed a casualty expectation of 1 in 10,000 for any single mission.

- Non-mission ships will be restricted from near-shore hazard areas, where the probability of impact of debris capable of causing a casualty exceeds 1 in 10,000 for non-mission ships.

- Non-mission aircraft in near-shore areas will be restricted from hazard volumes of airspace, where the cumulative probability of impact of debris capable of causing a casualty on an aircraft exceeds 1 in 10,000,000 for all non-mission aircraft. (RCC, 2007)

For comparison purposes, the 2005 average annual probability of fatality in the US from non-transportation accidental (unintentional) injuries was 1 in 4,274 (National Safety Council, 2009). This probability record included falls, fire and burns, drowning, electrical shock, and poisoning. Thus, the risk of fatality to the public from HTV-2 program launches at Vandenberg AFB would be substantially less than the risk from non-transportation related accidents. Overall, no significant impacts on health and safety are expected.

4.1.1.5.3 Post-Launch Operations

Post-launch maintenance and repairs at the SLC-8 launch pad are routine operations at Vandenberg AFB. All applicable Federal, state, and local health and safety requirements, such as OSHA regulations, would be followed, as well as all appropriate DOD and USAF regulations. By adhering to the established safety standards and procedures identified in Section 3.1.5, the level of risk to military personnel, contractors, and the general public would be minimal. Thus, no significant impacts on health and safety are expected.

4.1.1.6 Hazardous Materials and Waste Management

4.1.1.6.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

HTV-2 program related facility modifications and pre-launch preparations would not damage or interfere with existing IRP treatment and monitoring systems on base. Modifications to the IRF (Building 1900) are not expected to result in any asbestos or LBP wastes. If removal of asbestos and/or LBP was required, such hazardous wastes would require containerizing and proper disposal at the base landfill or at other permitted facilities located off base.

The launch vehicle integration and launch site preparations represent routine types of activities at the base. During pre-launch preparations, small quantities of lubricants, paints, sealants, and solvents (less than 10 lb [4.5 kg] per flight test vehicle) would be used. All hazardous materials and associated wastes would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.6. As an example, key elements in the management of hazardous liquids would include material compatibility, security, leak detection and monitoring, spill control, personnel training, and specific spill-prevention mechanisms. Whenever possible, HTV-2 related operations at Vandenberg AFB would use environmentally preferred and/or recyclable materials.

All hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, DOD, and USAF regulations. Hazardous material and waste-handling capacities would not be exceeded, and management programs would not have to change. Thus, no significant impacts from hazardous materials and waste management would occur.

4.1.1.6.2 Launch Activities

Flight activities would not normally release hazardous materials or generate hazardous waste. In general, IRP studies at Vandenberg AFB have not shown any long-term concerns for contamination to soils and groundwater from repeated launches of similar solid-propellant systems (USAF, 2006).

If an early launch abort were to occur, base actions would be taken immediately to recover unburned solid propellants and any other hazardous materials that had fallen on the beach, off the beach within 6 ft

(1.8 m) of water, or in any of the nearby freshwater creeks. Recovery from deeper water along the shoreline would be treated on a case-by-case basis. Collected waste materials would be properly disposed of in accordance with applicable regulations. Consequently, no significant impacts from the management of hazardous materials and waste are expected.

4.1.1.6.3 Post-Launch Operations

Post-launch maintenance and repairs at the SLC-8 launch pad are routine operations at Vandenberg AFB. During this process, all hazardous materials would be responsibly managed in accordance with the well-established policies and procedures identified in Section 3.1.6. Hazardous and non-hazardous wastes would be properly disposed of in accordance with applicable Federal, state, local, DOD, and USAF regulations. This requirement would include any stormwater buildup in the SLC-8 flame duct catchment basin. The stormwater would be sampled for contaminants and, depending on the results, the water would be discharged to grade or sent to the base industrial wastewater treatment plant.

Hazardous material and waste-handling capacities on base would not be exceeded, and management programs would not have to change. As a result, no significant impacts from the management of hazardous materials and waste would occur.

4.1.2 OVER-OCEAN FLIGHT CORRIDOR AND THE GLOBAL ENVIRONMENT

4.1.2.1 Global Atmosphere

4.1.2.1.1 Stratospheric Ozone Layer

Exhaust emissions from the rocket motors contain both Cl and Cl compounds, produced primarily as HCl at the nozzle. Two Minotaur IV Lite launches would release approximately 0.27 tons of Cl and 33 tons of HCl (see Table 4-3). The Cl and HCl would have a long enough tropospheric lifetime to eventually mix with the stratosphere, even when released at ground level. The global release of emissions from rocket launches, however, is small enough that it is not listed as a significant source of ozone depleting substances by the WMO (2006). It is also estimated that the emission loads of chlorine (as HCl and free Cl) from rocket launches worldwide, as projected from 2004 to 2014, would account for only 0.5 percent of the industrial Cl load from the US over the 10-year period (MDA, 2007a).

Both Al_2O_3 and NO_x are also of concern with respect to stratospheric ozone depletion. Two launches would release approximately 60 tons of Al_2O_3. The Al_2O_3 is emitted as solid particles and can activate Cl in the atmosphere. The exact magnitude of ozone depletion that can result from a buildup of Al_2O_3 over time has not yet been determined quantitatively, but is considered insignificant based on existing analyses (USAF, 2001). Following each launch, the majority of this compound would be removed from the stratosphere through dry deposition and precipitation. NO_x, like certain Cl compounds, also contributes to catalytic gas phase ozone depletion. The production of NO_x species from solid rocket motors is dominated by high-temperature “afterburning” reactions in the exhaust plume. As the temperature of the exhaust decreases with increasing altitude, less NO_x is formed. Because diffusion and winds would disperse the NO_x species generated, no significant effect on ozone levels is expected.

In summary, rocket emissions from the two proposed HTV-2 flight tests would not have a significant impact on stratospheric ozone depletion; however, any emission of ozone-depleting substances represents an incremental increase that could have incremental effects on the global atmosphere.

4.1.2.1.2 Greenhouse Gases and Global Warming

Under the Proposed Action, all combined HTV-2 activities at Vandenberg AFB and from launches would release approximately 304 tons (276 metric tons) of CO_2. Detailed emission calculations of GHGs from facility modifications and pre-launch preparations (including local rocket motor transportation), launch, and post-launch activities at Vandenberg AFB are provided in Appendix D.

A small number of support ocean vessels, aircraft, and other equipment would be used at USAKA/RTS and around the Marshall Islands to support HTV-2 terminal phase preparations and operations. Although the full extent of their use has not yet been determined, it is expected to be limited and temporary. In addition, the availability of GHG emission factors for vessels and some aircraft is limited. For these reasons, GHG emissions from such sources were not quantified in this analysis. The amount of emissions that would be released, however, is assumed to be negligible.

CO_2 is the only GHG identified in the Kyoto Protocol or the California Climate Action Registry that would be emitted during launch of the Minotaur IV Lite booster. Because of the solid propellant used, two launches would release only 4 tons (3.6 metric tons) of CO_2. For comparison, the CO_2 emissions from all USAF launch vehicles (e.g., Atlas, Delta, Titan, and Minuteman) in CY 2005 represents the emissions of 130 passenger cars operated that year (DeSain and Brady, 2007).

The amount of CO_2 released by all HTV-2 program activities is expected to be less than 0.0001 percent of the anthropogenic emissions for this gas released on a global scale annually (USEPA, 2007b). Although this limited amount of emissions would not contribute significantly to global warming, any emission of GHG represents an incremental increase that could have incremental effects on the global atmosphere.

4.1.2.2 Biological Resources

The proposed HTV-2 flight tests would not have a discernible or measurable impact on benthic or planktonic organisms, because of their abundance, their wide distribution, and the protective influence of the mass of the ocean around them. However, the potential exists for impacts to larger vertebrates in the nekton, particularly those that must come to the surface to breathe (e.g., marine mammals and sea turtles). Potential impacts on these protected species have been considered in this analysis and include the effects of sonic booms produced by flight vehicles, the effects of splash-down of launch vehicle stages, and release of propellants or other contaminants into the water. These issues are discussed further in the following sections.

4.1.2.2.1 Sonic Boom Overpressures

Open-Ocean Environments

As described in Section 4.1.1.2.2, launch of the Minotaur IV Lite booster from Vandenberg AFB would generate a sonic boom off the CA Coast in open-ocean areas. The propagation of sonic booms underwater could affect the behavior and hearing sensitivity in marine mammals (primarily cetaceans), sea turtles, and other fauna. If the sounds were loud enough, then they might cause animals to quickly react, briefly altering their normal behavior. Higher sound levels can impede a marine mammal’s ability to hear even after the exposure has ended, temporarily raising the threshold at which the animal can hear. Depending on the level of exposure, this threshold shift in hearing may be temporary (referred to as temporary threshold shift [TTS]) or permanent (referred to as permanent threshold shift [PTS]). TTS can temporarily impair an animal’s ability to communicate, navigate, forage, and detect predators. The onset of TTS in marine mammals depends on the total exposure to sound energy, a function of sound pressure level and duration of exposure. As a sound gets louder, the duration required to induce TTS gets shorter.

Exposure to sound in excess of that required to cause TTS may result in a PTS. (National Research Council, 2005)

Although sonic boom data for the Minotaur IV Lite booster is unavailable, prior studies of similar ICBM flight test vehicles launched from Vandenberg AFB have shown that maximum sonic boom overpressures would occur at distances of about 25 nmi (46 km) off the coast and last no more than 250 milliseconds or a quarter of a second (USAF, 2004). The surface footprint of the sonic boom can extend outward many miles on each side of the flight path, but it quickly dissipates with increasing distance. Using Atlas V sonic boom data (USAF, 2000) as a conservative estimate for the Minotaur IV Lite, the upper range of sonic boom overpressures generated by HTV-2 program launches would be 7.2 psf at the water's surface. This overpressure is equivalent to 145 dB (re 20 μPa) in air and 171 dB (re 1 μPa) in water at the air-to-water interface. The overpressure (sound levels) would dissipate with increasing distance and ocean depth.

Following HTV-2 separation from the booster, the test vehicle would also produce sonic booms during its hypersonic glide towards USAKA/RTS. Along its flight path, the vehicle would generate a moving sonic boom or carpet boom. The width of the boom "carpet" beneath the vehicle would be a little over 100 nmi (185 km). The carpet boom overpressures, however, would not be uniform. The maximum peak overpressure at ocean level would be around 0.21 psf directly beneath the vehicle, but then decrease laterally away from the flight path until the boom effects cease altogether. This overpressure would be equivalent to 114 dB (re 20 μPa) in air and 140 dB (re 1 μPa) in water at the air-to-water interface. Within the areas of the NWHI and Wake Island, the overpressures likely would not exceed 111 dB (re 20 μPa) in air and 137 dB (re to 1 μPa) underwater. Just as mentioned before, the overpressure (sound levels) would dissipate with increasing distance and ocean depth. A description of the methodology used to estimate the HTV-2 vehicle sonic boom overpressures is provided in Appendix E.

In response to consultations initiated by the USAF, the NMFS determined that the Minotaur IV Lite sonic boom impulsive sounds and resulting underwater overpressures (up to approximately 171 dB [re 1 μPa]) would exceed TTS thresholds for cetaceans (see Appendix A, page A-7). The HTV-2 vehicle carpet boom underwater effects (up to approximately 140 dB [re 1 μPa]) would not exceed such thresholds. These effects, however, would generate minimal in-water sonic boom footprints where adverse levels of sound may be encountered and the potential exposure would last for only a quarter second per flight test event at any given location along the flight path. Based on the limited area and duration of potential exposure to adverse sound levels, and the belief that ESA-listed marine species densities along the projected flight paths are low and patchy in distribution, the NMFS considered the potential acoustical effects to be discountable. The DARPA and USAF assume similar findings for other marine mammal species as well.

Sea turtle auditory sensitivity is not well studied; however, research suggests that the animals are less sensitive to the auditory effects of impulsive sounds than marine mammals (Ridgeway et al., 1969; USN, 2008a, 2008b). As noted in the NMFS letter (Appendix A, page A-7), the cetacean thresholds for TTS and PTS are likely to be particularly conservative for sea turtles. Thus, the Minotaur IV Lite sonic boom and HTV-2 carpet boom underwater acoustical effects on sea turtles can also be considered negligible.

Thus, the sonic booms generated along the over-ocean flight corridor are not expected to have a significant impact on marine mammals or sea turtles.

Terrestrial (Atoll/Island) Environments

During the Mission A flight test, the HTV-2 vehicle would pass directly over the NWHI and the Papahānaumokuākea Marine National Monument in the area of Maro Reef, Gardner Pinnacles, Brooks

Banks, and French Frigate Shoals. The resulting sonic boom carpet in this area would not be expected to exceed 0.15 psf (111 dB [re 20 μPa] in air). For the Mission B flight test, similar carpet boom overpressures might occur over Wake Island in the mid-Pacific. In comparison, these noise levels would be less than the 0.42 psf (120 dB [re 20 μPa] in air) overpressure produced by a thunderclap at close range (Vavrek et al., 2008). Because the carpet boom overpressures would occur only once at each location and last no more than a few hundred milliseconds, no significant impacts are expected to either terrestrial or marine species in these areas. Refer to Appendix E for information on the methodology used for estimating the HTV-2 vehicle sonic boom overpressures.

4.1.2.2.2 Direct Contact and Shock/Sound Wave from the Splashdown of Vehicle Components

As shown in Figure 2-4, the three Minotaur IV Lite spent rocket motors would impact in deep ocean waters, well away from coastal areas. The payload fairing would also impact in the same general area as the stage-3 motor. During their descents, each motor would hit the ocean surface at speeds of approximately 195 to 230 ft per second (59 to 79 m per second) (USAF, 2006). The expended motors—each weighing up to 9,431 lb (4,278 kg)—would have considerable kinetic force. Upon impact, this transfer of energy to the ocean water would cause a shock wave (low-frequency acoustic pulse) similar to that produced by explosives.

If a portion of the launch vehicle were to strike a protected marine mammal or sea turtle near the water surface, the animal would most likely be killed. In addition, the resulting underwater shock/sound wave radiating out from the impact point could potentially harm other animals. Close to the impact point, the shock/sound wave might cause PTS, injure internal organs and tissues, or prove fatal to the animals. Slightly further away, TTS effects might occur, but with increasing distance away from the impact point, pressure levels would decrease, as would the risk for injury. Figure 4-2 illustrates the relative distances for these shock/sound wave effects on animals.

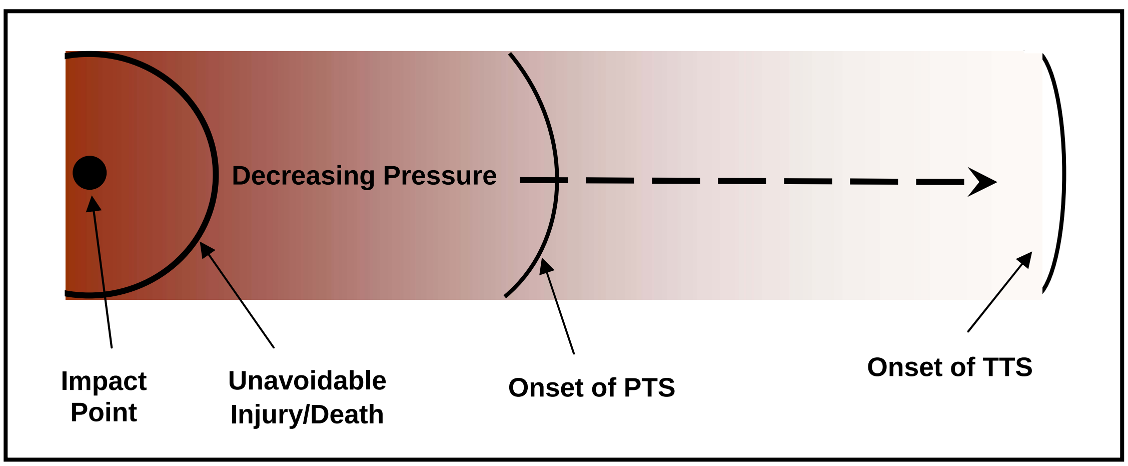


Figure 4-2. Illustration of the Relative Underwater Radial Distances for Shock/Sound Wave Effects on Marine Mammals and Sea Turtles

Research shows that an underwater sound level of approximately 240 dB (re 1 μPa) is the baseline criterion for defining unavoidable injury or death in marine mammals (Ketten, 1998). Such effects would occur within several feet or yards of each rocket motor impact point. For TTS and PTS effects on marine mammals and sea turtles, this EA used a dual-exposure criteria approach based on recent studies

conducted by the US Department of the Navy (USN) for underwater detonations and ship-shock trials (USN, 2008a, 2008b). The criteria use both peak pressure levels in dB (re 1 μPa) and energy flux density values, which are a measure of the sound energy flow per unit area expressed in dB (re 1 μPa2-s) for underwater sound. Table 4-4 presents the estimated radial distances for the onset of TTS and PTS for each booster component based on the USN criteria.

Table 4-4. Estimated Underwater Radial Distances for the Onset of TTS and PTS in Marine Mammals and Sea Turtles from Minotaur IV Lite Component Impacts in the Ocean

Potential Effect	Criterion	Criterion Source	Radial Distance from Impact Point ft (m)			
			Stage 1	Stage 2	Stage 3	Fairing
PTS	230 dB (re 1 μPa) peak pressure	USN, 2008b	4 (1.2)	4 (1.2)	2 (0.6)	1 (0.3)
	205 dB (re 1 μPa2-s) energy flux density	USN, 2008a	28 (8.5)	23 (7.0)	12 (3.7)	5 (1.5)
TTS	224 dB (re 1 μPa) [1] peak pressure	USN, 2008a, 2008b	9 (2.7)	7 (2.1)	4 (1.2)	2 (0.6)
	182 dB (re 1 μPa2-s) energy flux density	USN, 2008a	392 (119.5)	323 (98.5)	171 (52.1)	70 (21.3)

Notes:
[1] A peak pressure of 224 dB (re 1 μPa) is equivalent to 23 psi.

As Table 4-4 shows, the energy flux density criteria result in much larger radial distances for the onset of PTS and TTS, when compared to the peak pressure criteria results. In response to consultations initiated by the USAF, the NMFS determined that the Minotaur IV Lite component impacts are discountable because of broad distances (up to several hundred miles) between impact points and the expected low density of ESA-listed species across the open ocean (see Appendix A, page A-7). The DARPA and USAF assume similar findings for other marine mammal species as well.

As a result, the splashdown of Minotaur IV Lite components in the over-ocean flight corridor is not expected to have a significant impact on marine mammals or sea turtles.

4.1.2.2.3 Contamination of Seawater

By the time the spent rocket motors impact in the ocean, all of the solid propellants in them would be consumed. The residual aluminum oxide and burnt hydrocarbon coating the inside of the motor casings would not present any toxicity concerns. Although the nickel-cadmium batteries carried onboard the launch vehicle would be spent (discharged) by the time they impact in the ocean, small quantities of electrolyte material would remain in the batteries. The battery materials, along with several gallons of hydraulic fluid from each motor's TVC system, could mix with the seawater causing localized contamination. The release of such contaminants could potentially harm marine life that comes in contact with, or ingests, toxic levels of these solutions.

Previous studies of missile tests concluded that the release of hazardous materials carried onboard rocket systems would not be significant (USN, 2008a). Materials would be rapidly diluted in the seawater and, except for the immediate vicinity of the debris, would not be found at concentrations identified as

producing adverse effects. Ocean depths in the ROI reach thousands of feet and, consequently, any impacts from hazardous materials are expected to be insignificant. The area affected by the dissolution of hazardous materials onboard would be relatively small because of the size of the rocket components and the minimal amount of residual materials they contain. Such components would immediately sink to the ocean bottom, out of reach of marine mammals, sea turtles, and most other marine life. It is possible for deep-ocean, benthic species to be adversely affected by any remaining contaminants, but such impacts would be localized to within a short distance of rocket debris deposited on the ocean floor.

4.1.2.2.4 Failed or Terminated Launch

In the unlikely event of a system failure during launch or an early termination of flight, the launch vehicle would fall to the ocean intact or as debris scattered over a large area. It is expected that the falling debris would not have a significant impact on biological resources because of the large ocean area and the very low probability of striking a marine mammal or sea turtle.

Initiating flight termination after launch would split or vent the solid propellant motor casing, releasing pressure. Pieces of unburned propellant, which is composed of ammonium perchlorate, aluminum, and other materials, could be dispersed over an ocean area of up to several square miles. Of particular concern is the ammonium perchlorate, which can slowly leach out of the solid propellant resin binding-agent once the propellant enters the water. However, as described in Section 4.1.1.3.2, it is unlikely that perchlorate concentrations would accumulate to a level of concern. The overall concentration and toxicity of dissolved solid propellant from the unexpended rocket motors, or portions of them, is expected to be negligible and without any substantial effect. Any propellant fragments expelled from a destroyed or exploded rocket motor would sink hundreds or thousands of feet to the ocean floor. At such depths, the material would be beyond the reach of most marine life.

4.1.3 US ARMY KWAJALEIN ATOLL/RONALD REAGAN BALLISTIC MISSILE DEFENSE TEST SITE AND THE MARSHALL ISLANDS

4.1.3.1 Noise

4.1.3.1.1 Pre-Test Preparations and Support

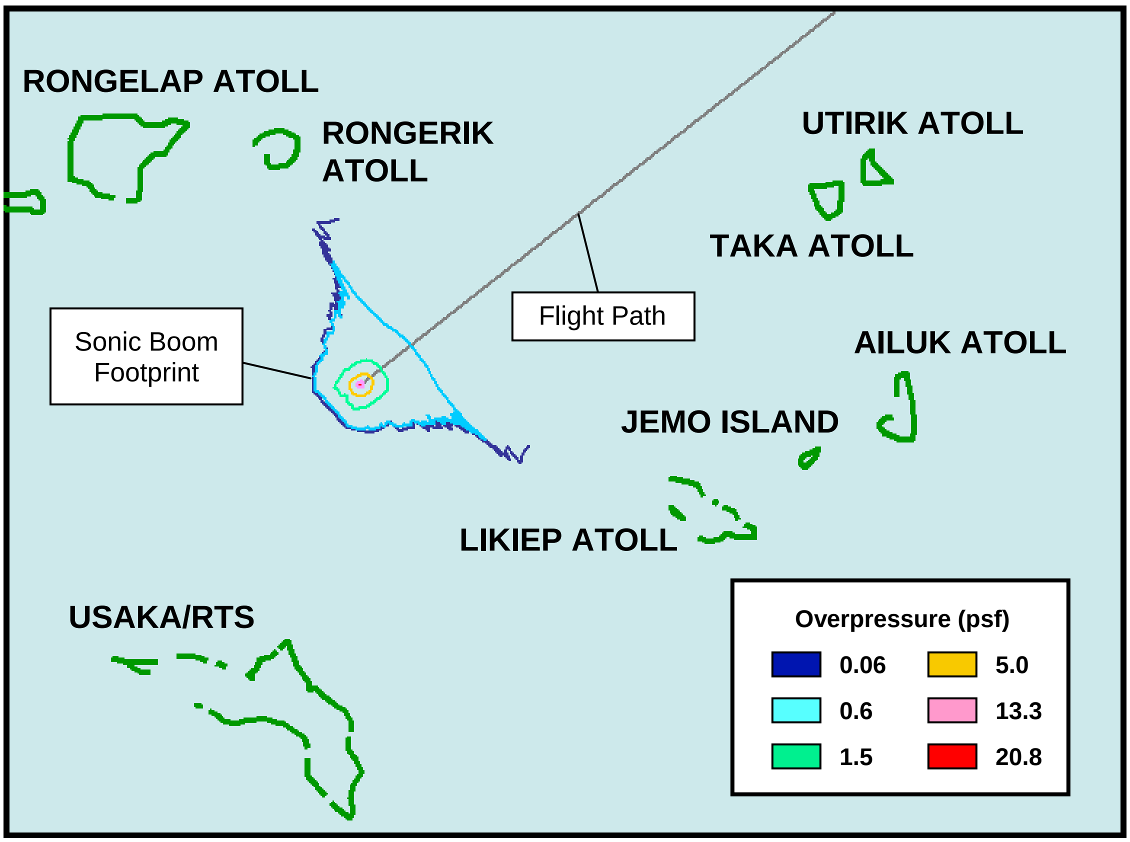
Vessel operations and other pre-test preparation activities in the Marshall Islands are not expected to have any noise impacts on local RMI communities.

4.1.3.1.2 Terminal Flight and Impact Activities

Terminal flight of the HTV-2 over the Marshall Islands would create a sonic boom carpet along its flight path, similar to that described in Section 4.1.2.2.1 for the over-ocean flight corridor. Because of the vehicle's high altitude (approximately 100,000 ft [30,480 m]), resulting sonic boom overpressures at sea level would be relatively low, ranging from about 0.12 to 0.21 psf (109 to 114 dB [re 20 μPa] in air). Because communities on Rongelap and Utirik Atolls would not be directly under the HTV-2 flight paths (see Figure 2-5), the sonic booms at these locations are expected to be around 0.12 psf (109 dB [re 20 μPa] in air). Such noise levels would be less than the 120 dB produced by a thunderclap at close range (Vavrek et al., 2008) and well within the OSHA standard of 140 dB (peak sound pressure level) for impulse noise (29 CFR 1910.95). The carpet boom would be audible only once at each location and last no more than a few hundred milliseconds.

Upon reaching the BOA north of USAKA/RTS, each HTV-2 vehicle would maneuver towards a pre-designated impact area in the ocean. During vehicle descent, a focused sonic boom would occur over a

wide area of the BOA. A representative focused boom footprint is shown in Figure 4-3. Sonic boom overpressures at ocean level would range from about 0.06 psf (103 dB [re 20 μPa] in air) along the outer edges of the footprint to approximately 26 psf (156 dB [re 20 μPa] in air) near the point of ocean impact. As Figure 4-3 shows, the focused boom footprint would not affect land areas. During the flight tests, personnel on mission support vessels in the vicinity of the impact area would comply with the applicable Army regulations for hearing conservation. Depending on vessel location, on-board personnel may be required to wear hearing protection. Refer to Appendix E for information on the methodology used for estimating the HTV-2 sonic boom overpressures.



Source: Modified from SMC, 2008

Figure 4-3. Representative Sonic Boom Footprint from HTV-2 Impact in the Broad Ocean Area

As a result, the sonic booms generated by the HTV-2 vehicle in the Marshall Islands are not expected to have a significant impact on the human environment.

4.1.3.1.3 Post-Test Operations

Noise from vessel operations would be similar to that of pre-test preparations. No noise impacts to local RMI communities are expected.

4.1.3.2 Biological Resources

4.1.3.2.1 Pre-Test Preparations and Support

In the BOA where the proposed HTV-2 impacts would occur, it is expected that sea turtles, whales, and other marine species occasionally pass through this deep ocean area during migrations or when moving to different feeding areas. Depending on HTV-2 mission requirements, one or two vessels would deploy up to approximately 16 free-floating rafts (with optical and/or acoustical sensors and telemetry equipment onboard) in this area prior to the flight test. These and other vessels may remain positioned in the vicinity of the BOA impact area just prior to testing.

During travel to and from impact and test support areas, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would also adjust their speed based on expected animal densities, and on lighting and turbidity conditions. The noise produced by the vessels might cause marine mammals and sea turtles to temporarily leave the area; however, these effects would be short-term and minimal. Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life. Thus, pre-test preparations would not have significant impacts on marine mammals or sea turtles.

If ship personnel observe marine mammals during deployment of the free-floating sensors in the BOA impact area, then they would report such sightings to the USAKA Environmental Management Office, the RTS Range Directorate, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list for consideration in approving the HTV-2 program launch. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of marine mammals.

4.1.3.2.2 Terminal Flight and Impact Activities

Terrestrial (Atoll/Island) Environments

As described in Section 4.1.3.1.2, the HTV-2 vehicle would create a sonic boom carpet along its flight path over the Marshall Islands, prior to maneuvering towards the BOA impact area. The carpet boom overpressures would be relatively low, ranging from about 0.12 to 0.21 psf (109 to 114 dB [re 20 μPa] in air). For the Mission A flight path, the carpet boom would likely be audible on Bikar, Taka, and Utirik Atolls. For Mission B, the carpet boom would likely be audible on Rongelap and Rongerik Atolls. In comparison, the noise levels would be less than the 0.42 psf (120 dB [re 20 μPa] in air) overpressure produced by a thunderclap at close range (Vavrek et al., 2008). Because the carpet boom overpressures would occur only once at each location and last no more than a few hundred milliseconds, no significant impacts are expected to either terrestrial or marine species in these areas.

Broad Ocean Area Environment

<u>Sonic Boom Overpressures.</u> Within the Marshall Islands, the HTV-2 carpet boom maximum peak overpressure is expected to be around 0.21 psf at sea level. This peak overpressure would be equivalent to 140 dB (re 1 µPa) in water at the air-to-water interface. Just as described in Section 4.1.2.2.1 for the HTV-2 over-ocean flight corridor, the carpet boom effects within the BOA north of USAKA/RTS and in other ocean areas of the Marshall Islands would have a negligible effect on marine mammals and sea turtles because: (1) the overpressures would generate minimal in-water footprints and be very short in duration; (2) underwater sound levels would not exceed NMFS thresholds for TTS or PTS; and (3) marine mammal and sea turtle species are believed to have low and patchy densities within the ROI.

As stated in Section 4.1.3.1.2, the HTV-2 vehicle would also create a focused boom as it maneuvers and descends towards a pre-designated impact area in the BOA. Predicted overpressures at ocean level would range from about 0.06 psf along the outer edges of the sonic boom footprint to approximately 26 psf near the point of ocean impact (see Figure 4-3). For such overpressures, the equivalent underwater sound level at the air-to-water interface would range from a low of about 129 dB (re 1 μPa) to a maximum of approximately 182 dB (re 1 μPa). Such underwater sound levels would be 6 dB higher than the maximum 176 dB (re 1 μPa) estimated for focused booms from ongoing ICBM hypersonic vehicle tests at USAKA/RTS (USAF, 2004). In response to consultations initiated by the USAF, the NMFS determined that the HTV-2 vehicle's focused boom would exceed TTS and PTS thresholds for cetaceans (see Appendix A, page A-7). These effects, however, would generate minimal in-water sonic boom footprints in the BOA and the potential exposure would last for only a fraction of a second per flight test event. Based on the limited area and duration of potential exposure to adverse sound levels, and the belief that ESA-listed marine mammal and sea turtle species densities in the BOA are low and patchy in distribution, the NMFS considered the potential acoustical effects to be discountable. The DARPA and USAF assume similar findings for other marine mammal species as well. Thus, the sonic booms generated by the HTV-2 vehicle are not expected to have a significant impact on marine mammals or sea turtles.

Direct Contact and Shock/Wave from the Splashdown of Vehicle Components. An HTV-2 test vehicle impacting in the BOA would result in underwater shock/sound waves comparable to the splashdown of the rocket motors described in Section 4.1.2.2.2, but with much greater force because of the vehicle's hypersonic velocity at the time of impact. Such shock/sound waves produce impulse or impact types of underwater noise similar to that of explosives. Any marine mammals or sea turtles within several yards of the point of vehicle impact would most likely be killed. As the shock/sound wave radiates away from the impact point, sound levels would decrease, as would the risk for injury or auditory effects (see Figure 4-2). Using the dual-exposure criteria (peak pressure and energy flux density) approach described in Section 4.1.2.2.2, Table 4-5 presents the estimated radial distances for the onset of TTS and PTS from the HTV-2 vehicle point of ocean impact.

Table 4-5. Estimated Underwater Radial Distances for the Onset of TTS and PTS in Marine Mammals and Sea Turtles from HTV-2 Vehicle Ocean Impacts

Potential Effect	Criterion	Criterion Source	Radial Distance from Impact Point ft (m)
PTS	230 dB (re 1 μPa) peak pressure	USN, 2008b	31 (9.4)
	205 dB (re 1 μPa2-s) energy flux density	USN, 2008a	190 (57.9)
TTS	224 dB (re 1 μPa) [1] peak pressure	USN, 2008a, 2008b	61 (18.6)
	182 dB (re 1 μPa2-s) energy flux density	USN, 2008a	2,690 (819.9)

Notes:
[1] A peak pressure of 224 dB (re 1 μPa) is equivalent to 23 psi.

As Table 4-5 shows, the energy flux density criteria result in much larger radial distances for the onset of PTS and TTS, when compared to the peak pressure criteria results. In response to consultations initiated by the USAF, the NMFS determined that the HTV-2 vehicle impacts are discountable because there would be only two impact events and because of the expected low density of ESA-listed species within the BOA (see Appendix A, page A-7). The DARPA and USAF assume similar findings for other marine mammal species as well. The fact that no dead or injured whales or other marine mammals have been reported to USAKA/RTS officials over the years of ICBM vehicle testing demonstrates that the risk to animals is negligible (USAF, 2004).

To help ensure that marine mammals are not impacted, ship personnel supporting pre-test preparations in the BOA impact area (see Section 4.1.3.2.1) would report any marine mammal sightings to the USAKA Environmental Management Office, the RTS Range Directorate, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list for consideration in approving the HTV-2 program launch. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of marine mammals.

As a result, splashdown of the HTV-2 vehicle in the BOA is not expected to have a significant impact on marine mammals or sea turtles.

<u>Contamination of Seawater.</u> As described in Section 2.1.1.2, the HTV-2 vehicle would contain some hazardous materials, consisting of small quantities of toxic metals, batteries, and small explosive devices used during flight. Upon ocean impact, the vehicle would likely break up. No floating debris is expected and all hazardous materials would sink thousands of feet to the ocean floor, out of reach of marine mammals, sea turtles, and most other marine life. Should any battery electrolyte materials be released into the water, they would rapidly dilute in the seawater. As a result, no significant impacts are expected.

4.1.3.2.3 Post-Test Operations

Ocean travel and the recovery of free-floating sensors from the BOA would be conducted in a similar manner as during their initial deployment (see Section 4.1.3.2.1). Vessel operations are not expected to have a significant impact on marine mammals and sea turtles. No floating debris from the HTV-2 ocean impacts is expected. If ship personnel were to find floating debris from the vehicle, it would be collected for proper disposal.

Although unlikely, any dead or injured marine mammals or sea turtles sighted during sensor recovery operations would be reported to the USAKA Environmental Management Office, which would then inform the NMFS in Honolulu. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of dead or injured mammals. If an accidental take were to occur as a result of the HTV-2 ocean impact, the DARPA and the USAF would consult with USAKA/RTS, USASMDC/ARSTRAT, and the NMFS in Honolulu to formulate a mitigation/action plan to be integrated into future flight test planning to reduce the risk of accidental takes.

4.1.3.3 Health and Safety

4.1.3.3.1 Pre-Test Preparations and Support

HTV-2 test support preparations at USAKA/RTS would not introduce new types of activities or increase levels of risk to personnel. Use of existing tracking radars and sensors would continue in accordance with ongoing support activities. Prior analyses of the radars and sensors at USAKA/RTS determined that there

would be no significant impacts to workers and the public from non-ionizing (radio frequency) radiation because of operational safety procedures in place (USASSDC, 1993).

For the deployment of mobile sensors in the BOA, vessels would only be used when weather and sea conditions were acceptable for safe travel. Sensor deployment operations would not involve the handling or use of hazardous materials, other than batteries and small quantities of diesel fuel and/or gasoline.

Thus, pre-test preparations would not have a significant impact on health and safety.

4.1.3.3.2 Terminal Flight and Impact Activities

Through the application of USAKA/RTS range safety requirements described in Section 3.3.3, test programs are conducted with minimal risk to military personnel, contractors, and the general public. For the two HTV-2 flight tests, safety personnel at both Vandenberg AFB and USAKA/RTS would closely coordinate development of risk analyses based upon the trajectory, probability for system failure, and the population density of islands near the flight path. Computer-monitored destruct lines, based on no-impact lines, are pre-programmed for the Flight Safety software to avoid any falling debris on inhabited areas, as per Space System Software Safety Engineering protocols and US range operation standards and practices. As Figure 2-5 shows, the representative terminal flight paths for both HTV-2 missions would avoid overflight of RMI communities on Rongelap and Utirik Atolls.

The USAKA/RTS Safety Office would not allow the HTV-2 flight tests to proceed if the calculated risk exceeds the RCC 321-07 criteria, which requires that individuals within the general public not be exposed to a probability of casualty greater than 1 in 1,000,000 for any single mission. Preliminary analyses of the proposed flight tests by DARPA indicate an individual casualty risk level of approximately 1 in 1 billion within the RMI—well within the RCC standard.

As described in Section 3.3.3, NOTMARs and NOTAMs would be issued prior to each flight test to warn mariners and pilots to avoid the BOA impact area. Only mission-essential vessels would be allowed in the vicinity of the impact area. Radar sweeps by USAKA/RTS land-based and sea-based sensors (e.g., US Army Great Bridge and USAV Worthy), in addition to visual surveys by ship personnel, would help to ensure that the impact area is clear of non-mission ships and aircraft prior to tests.

As a result, HTV-2 terminal flight activities and ocean impact are not expected to have a significant impact on health and safety.

4.1.3.3.3 Post-Test Operations

Activities for the recovery of mobile sensors in the BOA would be similar to those conducted during sensor deployment; thus, no significant impacts are expected. Vessels would only be used when weather and sea conditions were acceptable for safe travel.

4.2 ENVIRONMENTAL CONSEQUENCES OF THE NO ACTION ALTERNATIVE

Under the No Action Alternative, the HTV-2 flight tests would not be implemented at Vandenberg AFB, USAKA/RTS, or anywhere else in the Marshall Islands. As a result, there would be no HTV-2 related environmental impacts from facility modifications, launch activities, or terminal flight operations. Vandenberg AFB and USAKA/RTS would continue ongoing operations with environmental conditions expected to remain unchanged from that described for the Affected Environment in Chapter 3.0 of the EA.

4.3 CUMULATIVE EFFECTS

Cumulative effects are considered to be those resulting from the incremental effects of an action when considering past, present, and reasonably foreseeable future actions, regardless of the agencies or parties involved. In other words, cumulative effects can result from individually minor, but collectively potentially significant, impacts occurring over the duration of the Proposed Action and within the same geographical area.

The following sections describe the potential for cumulative impacts to occur at Vandenberg AFB, at USAKA/RTS and elsewhere in the Marshall Islands, and within the global environment as a result of implementing the proposed HTV-2 flight tests.

4.3.1 VANDENBERG AIR FORCE BASE

The proposed Minotaur IV Lite launches would be conducted in a manner similar to that of other launch systems in use at Vandenberg AFB. The expected launch rate forecast for Vandenberg AFB is presented in Table 4-6 for CY 2008 and 2009. Beyond CY 2009, similar launch rates are expected. For the HTV-2 program, only two Minotaur IV Lite launches would be conducted within the CY 2009 timeframe. Thus, the proposed HTV-2 program launches represent a 10.5 percent increase in the number of launches per year (on average) at Vandenberg AFB.

Table 4-6. Launch Rate Forecast for Vandenberg AFB, CA

Launch System	Calendar Year	
	2008	2009
Atlas V	1	1
Delta II	2	2
Delta IV	1	0
Falcon	0	2
Taurus	1	1
Minotaur	1	1
Minuteman	4	4
BMDS Programs	9	3
Pegasus	3	2
Current Launch Rate Totals	**22**	**16**

Source: Leventis, 2007; Naputi, 2007; USAF, 2006.

The potential for cumulative impacts to occur at Vandenberg AFB is discussed in the following paragraphs for each affected resource.

Air Quality. Under the Proposed Action, minor temporary increase in air emissions would occur, primarily from site modifications, pre-launch, and launch activities. Additionally, other projects and activities would occur at Vandenberg AFB and within the region, resulting in some measurable amounts of air pollutants. The State of California and Santa Barbara County take into account the effects of all past, present, and reasonably foreseeable activities during the development of their State Implementation Plan (as required by the Clean Air Act) and County Clean Air Plan. Estimated emissions generated by the Proposed Action would be below *de minimis* levels and conform completely to these plans.

Therefore, implementation of the Proposed Action would not contribute to adverse cumulative air quality impacts.

The proposed Minotaur IV Lite booster would generate fewer emissions than the larger spacelift systems (e.g., Atlas and Delta) in use at the base. In addition, HTV-2 program launches and other rocket launches represent short-term, discrete events that would occur at different times and at different locations across Vandenberg AFB. The emissions would not accumulate because winds quickly and effectively disperse them between launches. Consequently, no significant cumulative impacts to air quality are anticipated.

Noise. While the HTV-2 program launches would occur from SLC-8, other launch programs would be conducted from multiple locations across the Vandenberg AFB. The Minotaur IV Lite launch vehicle would generate lower noise levels per launch, when compared to the larger spacelift systems in use (e.g., Atlas and Delta). Despite the increase in number of launch events, the noise generated by each HTV-2 program launch would be very brief, launches would occur only twice within a 1-year period, and they would not have a perceptible impact on cumulative noise metrics, such as the CNEL. Thus, implementation of the HTV-2 flight tests at Vandenberg AFB is not expected to result in any significant cumulative impacts on noise.

Biological Resources. The proposed HTV-2 program would increase the number of rocket launches at Vandenberg AFB, resulting in an increase in launch noise and rocket emissions released. The HTV-2 and other program launches represent short-term, discrete events that would occur at different times and at different locations across the base. Through coordination and consultations with the USFWS and the NMFS, the USAF implemented various plans and measures to limit the extent and frequency of potential impacts on protected and sensitive species. In addition, monitoring of certain species during launches is conducted on a regular basis to ensure that no long-term or cumulative impacts occur. To address the short-term disturbance of threatened and endangered species from launches, the USFWS authorized the incidental harassment of certain terrestrial and freshwater species. For the harassment of marine mammals (pinnipeds), the NMFS granted a take permit for Vandenberg AFB that covers a forecast of up to 30 launches per year. As discussed earlier and shown in Table 4-6, the addition of two HTV-2 program launches would not cause the take permit forecast limit to be exceeded.

Although the HTV-2 program actions would result in an increase in the number of short-term impact events at the range, no long-term cumulative effects on biological resources are anticipated. Consequently, no significant cumulative adverse effects on threatened and endangered species or sensitive habitats are expected to occur.

Cultural Resources. Vandenberg AFB has an Integrated Cultural Resources Management Plan already in place for the long-term protection and management of cultural resources that occur on the base. In accordance with Federal and state regulations, and agreements with the California SHPO, Vandenberg AFB personnel also regularly coordinate and consult with the SHPO and Native American specialists prior to implementing new projects where historical, archaeological, or traditional resources could be affected. As part of normal procedures, workers are informed of the sensitivity of cultural resources and the mitigation measures that might be required if sites are inadvertently damaged or destroyed, and security forces regularly patrol the base to help prevent potential vandalism and looting of such resources. Because of the requirements and procedures already in place, and the limited potential for proposed HTV-2 program activities to affect cultural resources on base, implementation of the HTV-2 program at Vandenberg AFB is not expected to result in any significant cumulative impacts on these resources.

Health and Safety. On Vandenberg AFB, all projects must comply with applicable standards, policies, and procedures for health and safety. All rocket launches and other hazardous operations are closely reviewed and analyzed to ensure that there are no unacceptable risks to the public, military personnel, and

contractors. Because implementation of the HTV-2 program would also comply with these same requirements, no significant cumulative impacts to health and safety are expected to occur.

Hazardous Materials and Waste Management. Implementing the HTV-2 program at Vandenberg AFB would not introduce new hazardous materials and wastes, and only a small increase in wastes would be expected from the two proposed launches. Therefore, no significant cumulative impacts from the management of hazardous materials and waste are anticipated.

4.3.2 OVER-OCEAN FLIGHT CORRIDOR AND THE GLOBAL ENVIRONMENT

Global Atmosphere. On a global basis, the two HTV-2 program launches would release negligible quantities of HCl and Cl emissions. Solid rocket motors make a relatively small contribution to stratospheric ozone losses, which are dominated by the release of CFCs and Halons. As for effects on global warming, the overall HTV-2 program would release a small quantity of CO_2 compared to anthropogenic releases worldwide. Currently, there are no standards to determine the significance of the cumulative impacts from these emissions. In the absence of any standards to the contrary, the amount of emissions associated with this project would not have a significant cumulative impact on stratospheric ozone depletion or on global warming.

Biological Resources. Potential cumulative impacts on marine life in the open ocean could occur from the two additional HTV-2 program launches, over and above projected launches identified in Table 4-6. Although Minotaur IV Lite booster and HTV-2 vehicle sonic booms could affect the behavior and hearing of marine mammals and sea turtles, the noise levels would be very short in duration at any given location and they would affect open ocean areas believed to have low and patchy densities of protected species. The sonic booms over the NWHI and Wake Island also would be minimal in strength and would occur only once at each location.

There would be a slight increase in the risk for spent booster motors to strike marine life in the open ocean, but again, protected marine mammal or sea turtle species are widely scattered and the probability for debris to strike an animal is very remote. The resulting shock/sound wave produced by the spent rocket motors as they impact the water could cause injury or death to animals close to the impact point and could lead to potential hearing loss in other animals nearby. However, the probability for such an occurrence is very low, considering the limited number of launches, the relatively low population distribution of animals in the open ocean, and the small size of the ocean areas affected by each launch. Thus, no significant cumulative impacts to terrestrial or marine life are anticipated.

4.3.3 US ARMY KWAJALEIN ATOLL/RONALD REAGAN BALLISTIC MISSILE DEFENSE TEST SITE AND THE MARSHALL ISLANDS

The proposed HTV-2 flight tests and impacts in the Marshall Islands would be conducted in a manner similar to that of the ongoing ICBM hypersonic vehicle tests conducted at USAKA/RTS (USAF, 2004). The two HTV-2 flight tests, however, would have minimal overlap with the ICBM tests in terms of ROI and potential for cumulative impacts. Discussions on each affected resource are provided in the following paragraphs.

Noise. The resulting HTV-2 sonic booms (carpet booms) over Rongelap and Utirik Atolls would also affect the local RMI communities, but only once within each community. No other USAKA/RTS-related flight test have been identified that would produce additional sonic booms in these same areas. Thus, no significant cumulative noise impacts to the RMI communities on Rongelap and Utirik Atolls would occur.

Biological Resources. Deployment of vessels and free-floating sensors in the BOA would have minimal overlap with other USAKA/RTS-related operations within the ROI. Thus, no cumulative impacts to biological resources are expected.

The HTV-2 vehicle carpet booms would occur only once at each location and they are expected to have minimal impacts on terrestrial and marine species. The focused booms in the BOA could affect the behavior and hearing of marine mammals and sea turtles; however, the noise levels would be very short in duration and they would affect open ocean areas believed to have low and patchy densities of protected species. The underwater shock/sound waves produced by the HTV-2 vehicle ocean impacts might cause brief startle responses in some animals; however, the probability for causing TTS, PTS, or other injuries can be considered discountable. Because only two HTV-2 flight tests are planned and they would not overlap with ongoing ICBM hypersonic vehicle tests, no significant cumulative impacts to biological resources would occur.

Health and Safety. Safety standards are high at USAKA/RTS and would serve to keep range safety related risks within acceptable levels for both workers and the public. The proposed HTV-2 program activities would not occur at the same time as other flight test programs, such as the Minuteman-III ICBM flight tests. No other projects in the ROI have been identified that would have the potential for incremental, additive cumulative impacts to health and safety. Thus, no significant cumulative impacts on health and safety are expected.

4.4 SUMMARY OF ENVIRONMENTAL MANAGEMENT AND MONITORING ACTIONS

Throughout this EA, various environmental management controls and monitoring systems are described. Required by Federal, state, DOD, and agency-specific environmental and safety regulations, these measures are implemented through normal operating procedures.

Although no significant or other major impacts are expected to result from implementation of the Proposed Action, some specific environmental management and monitoring actions have been identified to minimize the level of impacts that might occur at Vandenberg AFB and USAKA/RTS. These are summarized below and include the relevant sections of the EA where they are further described.

Vandenberg AFB

1) Program-related vehicles and other support equipment would be tuned and maintained to minimize engine exhaust emissions. (Section 4.1.1.1.1)

2) To minimize potential impacts on seal haul-outs and rookeries, and on seabirds, security helicopters or other aircraft overflights would maintain a minimum slant range of 1,000 ft (305 m) year round from shoreline areas between Point Pedernales and Oil Well Canyon just east of Rocky Point. (Section 4.1.1.3.2)

3) To minimize potential impacts on marine mammal species (pinnipeds), particularly from launch noise, launch operations at SLC-8 would comply with all acoustical and biological monitoring requirements, and other measures, identified in the NMFS programmatic take permit and current LOA. These requirements and measures would include:

   a) Scheduling missions, whenever possible, to avoid launches during the harbor seal pupping season (March 1 through June 30), unless constrained by factors including, but not limited to,

human safety, national security, or for a space vehicle launch trajectory necessary to meet mission objectives;

b) Conduct biological monitoring for all launches during the harbor seal pupping season in accordance with permit procedures, and report the results to the NMFS;

c) Conduct both acoustic and biological monitoring for all new space and missile launch vehicles during at least the first launch (including an existing vehicle from a new launch site), whether or not it occurs within the harbor seal pupping season. (Section 4.1.1.3.2)

4) To minimize potential long-term impacts on Federally threatened and endangered species at Vandenberg AFB, monitoring requirements would be conducted for HTV-2 program launches in accordance with existing USFWS biological opinions prepared for SLC-8. (Section 4.1.1.3.2)

5) Personnel would not be notified of the location of nearby archaeological sites unless the sites are to be specifically avoided by HTV-2 program activities. The base Environmental Office would brief personnel, as necessary, on the sensitivity of cultural resources, applicable Federal regulations, and the mitigation measures that might be required if sites are inadvertently damaged or destroyed. (Sections 4.1.1.4.1 and 4.1.1.4.3)

6) In the unlikely event that a flight termination or other launch anomaly were to impact land, response efforts would be coordinated with applicable range representatives and the California SHPO to develop the most appropriate mitigation measures based on the nature of the mishap and the cultural resources involved. (Section 4.1.1.4.2)

7) Whenever possible, HTV-2 program operations at Vandenberg AFB would use environmentally preferred and/or recyclable materials. (Section 4.1.1.6.1)

USAKA/RTS

1) During the HTV-2 flight tests, personnel on mission support vessels in the vicinity of the BOA impact area would comply with the applicable Army regulations for hearing conservation. Depending on vessel location, on-board personnel may be required to wear hearing protection. (Section 4.1.3.1.2)

2) During ocean travel to and from impact and test support areas, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would also adjust their speed based on expected animal densities, and on lighting and turbidity conditions. (Section 4.1.3.2.1)

3) Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life. (Section 4.1.3.2.1)

4) If ship personnel observe marine mammals during deployment of the free-floating sensors in the BOA impact area, they would report such sightings to the USAKA Environmental Management Office, the RTS Range Directorate, and the Flight Test Operations Director at Vandenberg AFB for incorporation into the launch prerequisite list for consideration in approving the HTV-2 program launch. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of marine mammals. (Sections 2.1.2.3.1 and 4.1.3.2.1)

5) Following each flight test, during recovery of free-floating sensors in the BOA, sightings of any dead or injured marine mammals or sea turtles would be reported to the USAKA Environmental Management Office, which would then inform the NMFS in Honolulu. USAKA/RTS aircraft pilots operating in the vicinity of the impact and test support areas near Roi-Namur Island would also report any opportunistic sightings of dead or injured mammals. If an accidental take were to occur as a result of the HTV-2 ocean impact, the DARPA and the USAF would consult with USAKA/RTS, USASMDC/ARSTRAT, and the NMFS in Honolulu to formulate a mitigation/action plan to be integrated into future flight test planning to reduce the risk of accidental takes. (Sections 2.1.2.3.3 and 4.1.3.2.3)

6) If any HTV-2 vehicle debris were found during vessel operations to remove free-floating sensors from the BOA, then the debris would be collected for proper disposal. (Section 4.1.3.2.3)

7) For the deployment of mobile sensors in the BOA, vessels would only be used when weather and sea conditions were acceptable for safe travel. (Sections 4.1.3.3.1 and 4.1.3.3.3)

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6.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED

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8.0 DISTRIBUTION LIST

The following is a list of agencies, organizations, and libraries that were sent a copy of the Draft EA/Draft FONSI for Hypersonic Technology Vehicle 2 Flight Tests.

Federal Agencies

National Marine Fisheries Service, Pacific Islands Regional Office, Honolulu, HI
National Marine Fisheries Service, Southwest Regional Office, Long Beach, CA
National Oceanic and Atmospheric Administration, Northwestern Hawaiian Islands Marine National Monument Office, Honolulu, HI
US Environmental Protection Agency, Region IX, San Francisco, CA
US Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, HI
US Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, CA

State and Local Agencies

California Coastal Commission, San Francisco, CA
California Department of Fish and Game, Santa Barbara, CA
California Department of Parks and Recreation, Office of Historic Preservation, Sacramento, CA
California Regional Water Quality Control Board, Central Coast Region, San Luis Obispo, CA
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Republic of the Marshall Islands

RMI Environmental Protection Authority

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Sierra Club, Santa Barbara, CA

Libraries

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Davidson Library, University of California, Santa Barbara, CA
Grace Sherwood Library, USAKA/RTS
Lompoc Public Library, Lompoc, CA
Roi-Namur Library, USAKA/RTS
Santa Barbara Public Library, Santa Barbara, CA
Santa Maria Public Library, Santa Maria, CA

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APPENDIX A

AGENCY CORRESPONDENCE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER (AFSPC)
LOS ANGELES AIR FORCE BASE, CALIFORNIA

19 Nov 2007

MEMORANDUM FOR SMDC-EN-V (Mr. Randy Gallien)

FROM: SMC/EAF
483 N. Aviation Blvd
El Segundo CA 90245-2808

SUBJECT: Request SMDC to participate as a Cooperating Agency in the Development of the Environmental Assessment for Hypersonic Technology Vehicle 2 Flight Tests

1. The US Air Force Space and Missile Systems Center (SMC) Acquisition Civil Environmental Engineer Division (EAF) is currently supporting the SMC Developmental Planning Directorate and the Defense Advanced Research Projects Agency (DARPA) in the preparation of an Environmental Assessment (EA) for two Hypersonic Technology Vehicle 2 (HTV-2) flight tests. Both flight test vehicles would be launched from Vandenberg Air Force Base, California, towards an impact site in the Broad Ocean Area near the US Army Kwajalein Atoll (USAKA) in the Republic of the Marshall Islands (RMI).

2. Because of your agency's technical expertise and legal responsibilities for actions involving USAKA and the RMI, we formally request the US Army Space and Missile Defense Command to participate as a cooperating agency under National Environmental Policy Act (NEPA) regulations (*see* 40 CFR §§ 1501.6, 1503.2, and 1508.5) in the development of the EA. No direct writing or analysis by your agency will be necessary for the document's preparation. The following are activities we will take to maximize interagency cooperation:

a) Invite you to coordination meetings and teleconferences

b) Consult with you on any relevant technical studies that will be required for the project

c) Confer with you on Appropriate Agency consultations, and let your office take the lead in conducting consultations that affect USAKA and the RMI

d) Organize joint field reviews with you

d) Provide you with project information, including study results

f) Include information in the project environmental documents that cooperating agencies need to discharge their NEPA responsibilities and any other

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requirements regarding jurisdictional approvals, permits, licenses, and/or clearances.

3. We look forward to your response to this request and your role as a cooperating agency on this project. If you have any questions or would like to discuss in more detail the project or our agencies' respective roles and responsibilities during the preparation of this EA, please contact Mr. Thomas Huynh at 310-653-1223 or Thomas.Huynh@LOSANGELES.AF.MIL.

VINCENT CAPONPON, GG-14
(Acting) Chief, Acq. Civil Env. Engineer Division

DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND/
ARMY FORCES STRATEGIC COMMAND
POST OFFICE BOX 1500
HUNTSVILLE, ALABAMA 35807-3801

REPLY TO
ATTENTION OF
SMDC-ENV-N

28 NOV 2007

MEMORANDUM FOR Space and Missile Systems Center, SMC/EAF (Mr. Thomas Huynh), 483 N. Aviation Blvd, El Segunda, CA 90245-2808

SUBJECT: Cooperating Agency in the Development of an Environmental Assessment for Hypersonic Technology Vehicle 2 (HTV-2)

1. Thank you for your memo of 19 Nov 07 requesting that USASMDC/ARSTRAT be a cooperating agency in the development of an Environmental Assessment for the Hypersonic Technology Vehicle 2 Flight Tests.

2. The USASMDC/ARSTRAT hereby agrees to participate as a cooperating agency and agrees to support the US Air Force Space and Missile Systems Center Acquisition Civil Environmental Engineer Division in these specific ways:

a. Active participation in coordination meetings and teleconferences.

b. Provide consultation on relevant technical studies that will be required for the project.

c. Confer on appropriate agency consultations and take the lead in conducting consultations that affect USAKA and the RMI.

d. Organize joint field reviews.

e. Review project information and studies.

f. Ensure NEPA compliance with requirements regarding jurisdictional approvals, permits, licenses, and clearances.

3. The POCs for this action are Mr. David Hasley, (256) 955-4170, email - david.hasley@us.army.mil, and Ms. Julia Elliott, (256) 955-4822, email - julia.elliott@us.army.mil.

DENNIS R. GALLIEN
Chief, Environmental Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
12200-2008-FA-0146

AUG 14 2008

David C. Hasley
Chief, NEPA Compliance Branch
Deputy Chief of Staff, Engineer
U.S. Army Space and Missile Defense Command
Huntsville, Alabama

Dear Mr. Hasley,

The U.S. Fish and Wildlife Service (Service) has reviewed the Final Draft Environmental Assessment (FDEA) for the Hypersonic Technology Vehicle 2 (HTV-2) Flight Tests. The FDEA was prepared by Acquisition Civil/Environmental Engineering Space and Missile Systems Center for the Tactical Technology Office. The following comments have been prepared pursuant to the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq*.; 83 Stat. 853], as amended; the Fish and Wildlife Coordination Act of 1934 [16 U.S.C. 661 *et seq*.; 48 Stat. 401], as amended; the Endangered Species Act of 1973 [16 U.S.C. 1531 et seq.; 87 Stat. 884], as amended; and other authorities mandating Service concern for environmental values. Based on these authorities, we offer the following comments for your consideration.

The proposed project involves conducting two HTV-2 flight tests in 2009. The HTV-2 payloads will be launched from Vandenburg Air Force Base, California, using Minotaur IV Lite Booster rockets. After the launching sequence, the HTV-2 payload will separate from the booster and glide across the upper atmosphere of the Pacific Ocean towards Kwajalein Atoll. Both flight tests will travel along a northern track and land in the Pacific Ocean, approximately 100 miles north of Kwajalein Atoll. To better monitor the terminal phase of the flight, land-based telemetry equipment (S-band transportable ground System Antenna or STGS) will be deployed at Wake Atoll.

The STGS is a portable telemetry system with a 12-foot parabolic antenna. The STGS will be transported to Wake Atoll as U.S. Air Force airfreight and deployed in advance of each flight test. A crew of 2 or 3 personnel will be required to set up and operate the STGS. The STGS deployment will last for one week, only. The STGS will need to be set up on a relatively flat, preferably paved area. A small satellite communications terminal, shelter and two generators will accompany the STGS and occupy a total area of about 1,000 square feet. It is possible that

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Mr. David Hasley 2

the STGS may be transported by vessel to Wake Atoll and unloaded at a dock. A landing craft may be used to make a beach landing to off-load the equipment in the event a docking facility is unavailable.

We do not anticipate significant impacts to fish and wildlife resources as a result of either the Proposed Action or the No Action Alternative. Deployment of the STGS and support equipment is not expected to affect fish and wildlife resources if the equipment is deployed on a flat, paved surfaced, such as the airport apron. Also, we do not anticipate impacts to fish and wildlife resources if the STGS and support equipment are transported to Wake Atoll by air or vessel with available docking facilities. However, it is possible that fish and wildlife resources may be affected if a landing craft is required to transport the STGS to Wake Atoll. In the event a landing craft landing is required, we recommend that the Service and National Marine Fisheries Service (NMFS) be contacted in advance to help define a path for the landing craft to make landfall and avoid unnecessary impacts to coral reef resources. It may be necessary for biologists from the Service and NMFS to make an on site visit to Wake Atoll and evaluate coral reef resources and define an appropriate path to land the landing craft.

The FDEA does not clearly state whether project support equipment will be transported through Guam to Wake Atoll. We are concerned that the alien brown tree snake may infiltrate cargo shipped through Guam and become accidentally introduced to Wake Atoll. Therefore, we recommend that project equipment avoid shipping through Guam. If project shipments must be shipped through Guam, then we recommend that all shipment containers be thoroughly inspected by trained professionals at U.S. Department of Agriculture for brown tree snakes.

The Service appreciates the opportunity to comment on the FDEA. If you have any questions regarding these comments, please contact Marine Ecologist Kevin Foster by telephone at (808) 792-9420 or by email (kevin_b_foster@fws.gov).

Sincerely,

Patrick Leonard
Field Supervisor

cc: NMFS-PIRO, Honolulu
USEPA-Region IX, San Francisco
SMDC-Huntsville
RMI-EPA
USAKA

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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OCT 2 8 2008

Mr. Vincent R. Caponpon
Acting Chief, Acq. Civil & Environmental Engineering
Department of the Air Force SMC/EAF
483 North Aviation Blvd.
El Segundo, CA 90245-2808

Dear Mr. Caponpon:

This letter responds to your June 23, 2008 letter regarding the proposal by the Defence Advanced Research Projects Agency (DARPA) and US Air Force Space and Missile Systems Center (SMC) to conduct two Hypersonic Test Vehicle 2 (HTV-2) test flights over the Pacific Ocean. In your letter, you made the determination that the proposed action "is not likely to adversely affect nine Endangered Species Act (ESA)-listed marine species". You further determined that "the proposed action will have no effect on the endangered sei whale, northern Pacific right whale, or Hawaiian monk seal, and requested the concurrence of the National Marine Fisheries Service (NMFS) Protected Resources Division (PRD) under Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*), with your determinations.

Proposed Action/Action Area: The proposed action consists of conducting two HTV-2 test flights during calendar year 2009. The test vehicles will be launched from Vandenberg Air Force Base, CA. Following in-flight testing, the HTV-2s will impact within the Broad Ocean Area (BOA) approximately 161 kilometers (km) north of Kwajalein Atoll. The action is described in detail in your Final Draft Environmental Assessment (DARPA & SMC 2008), which is hereby incorporated by reference. The action area for this action includes the area around the launch site, where marine life may be impacted by noise around the launch site. The action area also includes the ocean area under the flight paths where ESA-listed marine species and their habitats may be affected by sonic booms, and/or falling missile components such as booster stages and the HTV-2s.

Listed Species/Critical Habitat: ESA-listed species under NMFS jurisdiction that are known to occur, or could reasonably be expected to occur in waters of the Pacific Ocean under the proposed flight trajectories include green sea turtles (*Chelonia mydas*), hawksbill sea turtles (*Eretmochelys imbricata*), leatherback sea turtles (*Dermochelys imbricata*), loggerhead sea turtles (*Caretta caretta*), and olive ridley sea turtles (*Lepidochelys olivacea*), as well as blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*), North Pacific right whales (*Eubalaena japonica*), sei whales (*Balaenoptera borealis*), sperm whales (*Physeter macrocephalus*), and Hawaiian monk seals (*Monachus schauinslandi*).

Based on the exceptional rarity of North Pacific right whales in the action area, NMFS considers it discountable that North Pacific right whales will be affected by the proposed action, and concurs with your determination of no effect for that species, and they will be considered no further in this consultation. However, based on the knowledge that the remaining species are known to occur with some regularity in at least some parts of the action area, it is reasonable to expect that any of them could be exposed to impacts from the proposed action. This includes sei whales and Hawaiian monk seals.

The green sea turtle was listed as threatened on July 28, 1978 (43 CFR 32800), except for breeding populations found in Florida and the Pacific coast of Mexico, which were listed as endangered. The biology, habitat, and conservation status of this species is described in their recovery plan and in a recent status review (NMFS & USFWS 1998a & 2007a). Greens occur in the pelagic waters and around nearly all tropical to sub-tropical island groups in the Pacific Ocean (NMFS & USFWS 1998a). They are particularly numerous around Hawaii and are known to nest on several islands in the Marshall Archipelago and likely occur in the BOA.

The hawksbill sea turtle was listed as endangered on June 2, 1970 (35 CFR 8490). The biology, habitat, and conservation status of this species is described in their recovery plan and in a recent status review (NMFS & USFWS 1998b & 2007b). Hawksbills occur in low numbers in the pelagic waters and around nearly all tropical to sub-tropical island groups in the Pacific Ocean (NMFS & USFWS 1998b). Hawksbills are expected to occur around the islands and in the BOA of the Marshall Archipelago.

The leatherback sea turtle was listed as endangered on June 2, 1970 (35 CFR 8491). The biology, habitat, and conservation status of this species is described in their recovery plan and in a recent status review (NMFS & USFWS 1998c & 2007c). Leatherbacks occur in low numbers in tropical to sub-polar pelagic waters throughout the Pacific Ocean basin (NMFS & USFWS 1998c). Leatherbacks are expected to occur in the BOA of the Marshall Archipelago.

The loggerhead sea turtle was listed as threatened on July 28, 1978 (43 CFR 32800). The biology, habitat, and conservation status of this species is described in their recovery plan and in a recent status review (NMFS & USFWS 1998d & 2007d). Loggerheads occur in the sub-tropical to temperate pelagic waters across the Pacific Ocean (NMFS & USFWS 1998d). Although unlikely, they may occasionally occur in the BOA of the Marshall Archipelago.

The olive ridley sea turtle was listed as threatened on July 28, 1978 (43 CFR 32800), except for breeding populations found in Mexico, which were listed as endangered. The biology, habitat, and conservation status of this species is described in their recovery plan and in a recent status review (NMFS & USFWS 1998e & 2007e). Olive ridleys occur in tropical to sub-tropical pelagic waters across the Pacific Ocean (NMFS & USFWS 1998e), and are expected to occur in the BOA of the Marshall Archipelago.

The blue whale was listed as endangered on December 2, 1970 (35 CFR 18319). The biology, habitat, and conservation status of this species is described in the recovery plan (NMFS 1998). Blue whales occur with regularity off the coast of California. They are sighted near the Hawaiian

and Mariana Islands on rare occasions, and have been acoustically recorded near Wake Island. Although unlikely, they may occasionally occur in the BOA of the Marshall Archipelago.

The fin whale was listed as endangered on December 2, 1970 (35 FR 18319). The biology, habitat, and conservation status of this species is described in the draft recovery plan (NMFS 2006a). They are pelagic, and generally occupy coastal and shelf waters throughout the temperate to polar oceans of the world, but can also be found in deep open ocean waters. Fin whales are occasionally sighted near Hawaii. Although unlikely, they may occasionally occur in the BOA of the Marshall Archipelago.

The humpback whale was listed as endangered on December 2, 1970 (35 CFR 18319). The biology, habitat, and conservation status of this species is described in the recovery plan (NMFS 1991). Humpbacks winter-over in large numbers near the Hawaiian Islands. They also winter-over in the Marianas and off the California coast. Humpbacks may occasionally occur around the islands and in the BOA of the Marshall Archipelago.

The sei whale was listed as endangered on December 2, 1970 (35 FR 18319). The biology, habitat, and conservation status of this species is described in Leatherwood et al., 1988, and Reeves et al., 2002, and in several website articles (American Cetacean Society, 2008, and Shefferly, 1999). Sei whales distribution is poorly understood, but they seem to occur most often in temperate waters. They are pelagic, and generally occupy deep waters of the open ocean. In the North Pacific, they range from Guam to Hawaii to the coast of Mexico. It is unlikely that they occur in the BOA of the Marshall Archipelago.

The sperm whale was listed as endangered on December 2, 1970 (35 CFR 18319). The biology, habitat, and conservation status of this species is described in the draft recovery plan (NMFS 2006). Sperm whales occur in pelagic waters from the tropics to sub-polar seas (NMFS 2006). They are regularly sighted in the waters around the Hawaiian and Mariana Islands, and are also known to occur in the waters around Kwajalein.

The Hawaiian monk seal was listed as endangered on November 23, 1976 (41 FR 51611). The biology, habitat, and conservation status of this species is described in the recovery plan (NMFS 2007). They are endemic to the Hawaiian Archipelago, with the majority of the population residing in the Northwestern Hawaiian Islands (NWHI). However, they are increasingly found in the Main Hawaiian Islands (MHI).

Critical Habitat: Critical habitat was designated under the ESA for the Hawaiian monk seal on May 26, 1988. It is the only designated critical habitat within the action area, and extends from shore to a depth of 20 fathoms in ten areas of the NWHI. The flight path for Mission A takes an HTV-2 over the NWHI. However, the nearest booster section impact will occur nearly 1,800 km (1,000 nmi) away to the northeast, and the HTV-2 will be more than 45,700 m (150,000 ft) above the NWHI when it passes. A brief in-air sonic boom of 111 to 114 dB, (137 to 140 dB re 1 μPa in water) will pass across the area. This insignificant event is the only expected impact on critical habitat from this action.

Analysis of Effects: NMFS used the following information to determine effects of the proposed action: The SMC June 23, 2008, consultation request letter; the Draft Environmental Assessment (EA)(DARPA & SMC 2008), including all references therein; the July 14, and October 6, 2008, e-mails from Mr. David Hasley, USASMDC (USASMDC 2008a & b); and the September 17, 2008, e-mail from Mr. Craig Johnson, NMFS/PRD (NMFS 2008). In order to concur that a proposed action is not likely to adversely affect listed species, NMFS must find that the effects of the proposed action are expected to be insignificant or discountable, as defined in the joint USFWS-NMFS Endangered Species Consultation Handbook: (1) insignificant effects relate to the size of the impact and should never reach the scale where take occurs; (2) discountable effects are those that are extremely unlikely to occur; and (3) beneficial effects are positive effects without any adverse effects (USFWS & NMFS 1998). This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions between the marine listed species and the proposed action, were applied during the analysis of effects of the proposed action on ESA-listed marine species, and is outlined in detail below. Your effects analysis for the action took into account three distinct area-based phases: (1) Launch from Vandenberg AFB; (2) Over-Ocean Flight Corridor; and (3) Marshall Islands. The analysis considered potential stressors and impacts to marine listed species, the most likely of which are:

Launch from Vandenberg AFB: Since there are no ESA-listed marine species under NMFS jurisdiction in the areas adjacent to the launch facilities, no effects analysis/concurrence is required of NMFS for the pre-launch and launch phases.

Over-Ocean Flight Corridor - In-flight and booster impact effects of concern are:
1. Exposure to elevated noise levels;
2. Impact of falling missile components; and
3. Exposure to hazardous materials.

Marshall Islands - HTV-2 In-flight and impact effects of concern are:
1. Exposure to elevated noise levels;
2. Impact of falling missile components;
3. Exposure to hazardous materials;
4. Disturbance from human activity and equipment operation through aircraft and vessel operations around the islands and in the BOA; and
5. Collision with vessels;

1. Exposure to elevated noise levels: The rocket boosters used to launch the HTV-2s will produce high noise levels as the missiles arc over the ocean. The boosters are expected to begin generating sonic booms at about 46 km (25 nautical miles) off the coast. The HTV-2s will generate their own sonic booms through the duration of their flights, which will end with high level concussive noise generated by hypersonic impact with the water in the BOA. High intensity noises such as these may adversely affect marine life. Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the affected animal. Effects may include: (1) permanent hearing damage, also referred to as permanent threshold shift (PTS); (2) temporarily reduced sensitivity also referred to as temporary threshold shifts (TTS); (3) temporarily masked communications or acoustic environmental cues; and (4) modified behaviors.

Although sound pressure levels (SPL) can be measured and quantified in several ways, all systems use the logarithmic decibel (dB) scale as the common unit of measure. Sound behaves differently in water than it does in air. For example, sound is louder and travels faster in water than in air. In-water, sound pressure is typically referred to as dB referenced to a baseline of 1 micro pascal (re 1 μPa). To assess the potential impact of a sound on marine resources, NMFS uses the root-mean-square (rms) of a sonic pulse, which is the portion of a pulse that contains 80% of the sound energy. For cetaceans, NMFS has established exposure to sounds in water, at or above 180 dB_{rms} re 1 μPa, as the threshold for PTS, whereas exposure to impulse sounds of 160 dB_{rms} re 1 μPa or continuous sounds of 120 dB_{rms} re 1 μPa, as likely to cause TTS and behavioral effects. Research into sea turtle sensory biology suggests that sea turtles are much less acoustically sensitive than cetaceans (Hazel, et al. 2007 & Ridgeway et al. 1969). Thus, use of the cetacean thresholds for sea turtles is expected to be particularly conservative.

Sonic impacts will be limited to those of two flights along different flight paths, conducted with an unspecified temporal separation. Although the at-the-surface acoustic footprint of these flights may extend many miles, the maximum SPLs described below will occur directly beneath the vehicle, and the in-water SPL will drop quickly with distance from that point (DARPA & SMC 2008).

The launch vehicle rocket motor will generate relatively low frequency broadband noise with a maximum in-water SPL of about 137 dB re 1 μPa when the vehicle is at low altitude and very close to shore. Rocket motor noise will build to a peak and then fade away as the missile approaches and passes a given point. Exposure duration will be a few seconds, and in-water SPL will diminish as the vehicle gains altitude.

The launch vehicle will eventually generate a sonic boom. Sonic booms are high intensity, low frequency, short duration sonic events. Frequencies are generally below 1 kHz (USASMDC 2008a), and a boom typically last no longer than 250 milliseconds (1/4 of a second) as it passes a given location. The maximum expected SPL for the launch vehicle's sonic boom, 171 dB re 1 μPa in water, will occur at about 46 km (25 nautical miles) off the California coast, and will decrease as the vehicle gains altitude (DARPA & SMC 2008). The maximum expected SPL for the HTV-2 sonic boom is 143 dB re 1 μPa in water. The expected SPL for the HTV-2 while over the NWHI is 111 to 114 dB in air, and 137 to 140 dB re 1 μPa in water (USASMDC 2008a), which is well below the TTS threshold. During the terminal phase of the flight, the HTV-2 will generate a sonic boom, with a maximum SPL of 182 dB re 1 μPa in water, just prior to impact.

Launch vehicle rocket motor noise is above the TTS threshold for continuous sound. The launch vehicle sonic boom is above the TTS threshold for impulsive sounds, and HTV-2's terminal phase sonic boom is above the PTS threshold. However, these in-flight sources are expected to generate minimal in-water sonic footprints where adverse levels of sound may be encountered, and the potential exposure window consists of a single 1/4-second event per flight at any given location along the flight path. Based on the limited area for potential exposure to adverse sound levels, the brief duration of the sound, and on the belief that ESA-listed marine species density along the projected flight paths is low and patchy in distribution, we consider it discountable that ESA-listed marine species will be exposed to adverse levels of noise related to this action.

2. Impact of falling missile components: The test flights will result in a maximum of ten impact events; three boosters, one fairing, and one HTV-2 per mission. Booster stages 1-3 weigh about 44,500 kg, 24,500 kg, and 7,100 kg, respectively, and are expected to impact at about 69-79 m/sec. The HTV-2 weighs about 1,100 kg, and will impact at a much higher velocity. These impacts are expected to generate concussive noise events similar to explosive detonations (DARPA & SMC 2008). The weight and impact velocity of the fairing was not given, but is expected to be much lower than the other components. These impact events may adversely affect ESA-listed marine species through injury due to direct contact or barotrauma due to close proximity to the concussive forces, or through exposure to adverse levels of sound. Based on the impact analysis for the HTV-2, the concussive force is expected to exceed 240 dB re 1 μPa at the point of impact, and any ESA-listed marine species within 9 m (31 ft) of an impact point will likely be killed by direct contact or from injuries caused by the shock wave (DARPA & SMC 2008). Outside of that range, auditory injuries may occur with decreasing severity as range from the source increases.

The applicant based their acoustic analysis on sound exposure level (SEL) values used in the US Navy's recent FEIS for the Hawaii Range Complex, in which SELs of 205 and 182 dB re 1 μPa^2-s for PTS and TTS, respectively (USASMDC 2008b). These values are thought to accurately predict potential impacts on cetaceans from acoustic sources due to in-water detonations. It is interesting to note at this point that these values are well below (more conservative than) the 215 and 195 dB re 1 μPa^2-s levels used to predict PTS and TTS for tactical mid-frequency sonars.

Acoustic levels from HTV-2 impact are calculated to fall below PTS and TTS thresholds at 58 m (190 ft) and 820 m (2,690 ft), respectively. The acoustic levels from stage 1 booster impact are calculated to fall below PTS and TTS thresholds at 9 m (28 ft) and 122 m (392 ft), respectively (USASMDC 2008b).

Accurate population estimates and migratory routes are unavailable for the marine species covered in this consultation. Thus, calculating the potential for adverse effects due to impact is not currently possible. However, NMFS concurs with the EA in that the density of ESA-listed marine species along the projected flight paths is likely very low and that distribution is patchy. Based on the low number of impact points (10), on the expected separation between impacts (upwards of thousands of miles between impact points), on the small hazard area of the greatest impact source (HTV-2), and the expected low density of ESA-listed species across the ocean, the likelihood of an animal being adversely affected by an impact is closely analogous with the likelihood of a person being stuck by a falling meteor or by a piece of debris falling from a plane over-head. Thus, NMFS considers it discountable that ESA-listed marine species will be adversely affected by acoustic effects due to impact events related to this action. The applicant will further reduce the likelihood of adverse effects due to impacts by searching the BOA for protected marine species prior to each launch, and reporting the search results to Vandenberg for inclusion in their launch decision analysis.

3. Exposure to hazardous materials: Missile launches will introduce chemicals such as propellant, hydraulic fluids, battery fluids, and some heavy metals into the marine environment, due to splashdown of booster sections and the HTV-2 vehicles. Vessel and heavy equipment operation related to monitoring the terminal phase of the HTV-2 flights may also introduce wastes or discharges into the marine environment.

As stated in the EA, the inside of spent rocket motor casings will contain only a residual coating of aluminum oxide and burnt hydrocarbons. The amount of other toxic substances, such as battery and hydraulic fluids and heavy metals would be small. Additionally, these substances, along with the structural debris, would immediately sink to several thousand feet, well away from ESA-listed marine species. Based on the low volume of toxic materials involved and the depth of its deposition, ESA-listed marine species are highly unlikely to encounter significant concentrations of toxicants from spent booster sections. In the unlikely event of a launch failure, unburned solid propellant would likely enter the marine environment. However, the leaching rate of ammonium perchlorate in ocean water is very low, and the material will likely be spread out over a large area and in deep water. Thus, slow dilution over many years is expected to prevent accumulation of toxic concentrations.

The HTV-2 vehicle contains small quantities of hazardous materials, consisting of toxic metals (10 g of beryllium and 1.8 kg of chromium), batteries, and small electro-explosive devices (1.4 kg) used during flight. As stated in the EA, the vehicle will likely break up on impact and sink thousands of feet to the ocean floor, where these materials will rest or be rapidly diluted in the seawater. No floating debris is expected, but if any is detected, it will be collected for proper disposal.

Vessel and heavy equipment operations produce wastes that could potentially harm ESA-listed marine species. Local and Federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. As stated in the EA, the applicant has plans in place to remove all free floating sensors and HTV-2 debris from the BOA, and to remove all hazardous material and solid wastes from the islands(s) used by the telemetry radar crew. Additionally, the limited number of test flights (2) and the small window for monitoring operations is expected to limit the number of sea days involved and reduce the opportunity for discharge. Thus, we expect that discharges and spills are unlikely to occur, but will be infrequent, small, and quickly cleaned, diluted/dispersed if they do occur. Based on the information above, exposure to hazardous materials from missile components or from vessel/heavy equipment operations related to this action will likely have insignificant affects on ESA-listed marine species.

4. Disturbance from human activities and equipment operation. As stated in the EA, aircraft over-flights, vessel operations to place and recover remote sensors within the BOA, as well as vessel or aircraft operations performed to set-up and recover a temporary land-based telemetry radar system may startle ESA-listed marine species should they encounter them. However, sea turtles and marine mammals typically avoid human marine activities. Based on this, the most likely effect of this interaction will be moderate level stress with a moderate to high energy avoidance behavior leading to the animal rapidly leaving the area without injury. Additionally, the applicant will reduce the likelihood of this interaction by watching for and avoiding protected marine life while operating vessels. Based on the above, we expect that disturbances related to

this action will be infrequent and non-injurious, resulting in insignificant effects on the sea turtles and whales covered by this consultation.

5. Collision with vessels. As stated in the EA, sea turtles and whales breathe air and must surface to breathe. They are also known to rest or bask at the surface. Therefore, when at or near the surface, turtles and whales are at risk of being struck by vessels or their propellers as the vessels transit to and from the project site. Potential injuries and their severity will depend on the speed of the vessel, the part of the vessel that strikes the animal, and the body part impacted. Injuries from boat strikes may include bruising, broken bones or carapaces, and lacerations. In the case of sea turtles, collisions with even small vessels can result in the turtle's death. Being much larger, whales are less likely to be killed immediately by a collision with a small boat, or a slow moving larger vessel, but they can be seriously injured by propellers. Serious injuries could eventually lead to the whale's death should there be significant blood loss and/or infection, or from predation while the whale is in a weakened state.

The recovery plans for the sea turtles and whales covered by this consultation indicate that the potential for boat collisions exists and that the incidence of collisions appears to be directly correlated with animal density and vessel traffic and speed. Existing information about sea turtle sensory biology suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance (Hazel, et al. 2007 & Ridgeway et al. 1969). Research also suggests that sea turtles cannot be expected to consistently notice and avoid vessels that are traveling faster than 2 knots (kts) (Hazel et al., 2007). Vanderlaan and Taggart (2007) report that the severity of injury to large whales is directly related to vessel speed. They found that the probability of lethal injury increased from 21%, for vessels traveling at 8.6 kts, to over 79% for vessels moving at 15 kts or more. Additionally, since collisions with whales have been reported for both slow and fast moving craft, it appears that, in at least some situations, whales may either be unaware of a vessel's presence or unable to resolve its proximity and/or vector of travel based on available acoustic cues. Consequently, vessel operators must be responsible to actively watch for and avoid sea turtles and marine mammals, and to adjust their speed based on expected animal density and on lighting and turbidity conditions to allow adequate reaction time to avoid marine animals.

Based on the expected low density of sea turtles and whales in the action area, the limited number of trips involved, and on the applicant's plan to watch for and avoid protected species, we consider the risk of collisions between project-related vessels and protected species to be discountable.

Conclusion: NMFS PRD concurs with your determination that conducting two HTV-2 test flights over the Pacific Ocean is not likely to adversely affect ESA-listed marine species or their designated critical habitat. Our concurrence is based on the finding that the effects of the proposed action are expected to be insignificant, discountable, or beneficial as defined in the joint USFWS-NMFS Endangered Species Consultation Handbook (USFWS-NMFS 1998) and summarized at the beginning of the Analysis of Effects section above.

This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. Consultation must be reinitiated if: 1) a take occurs; 2) new information reveals

effects of the action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the identified action is subsequently modified in a manner causing effects to listed species or designated critical habitat not previously considered; or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

If you have further questions please contact Donald Hubner on my staff at (808) 944-2233. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

William L. Robinson

William L. Robinson
Regional Administrator

Cc: Lisa Van Atta – Acting ARA PR, PIRO
Gerry Davis – ARA HC, PIRO

NMFS File No. (PCTS): I/PIR/2008/03806
PIRO Reference No.: I-PI-08-692-CY

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Electronic Message from NOAA National Marine Fisheries Service

-----Original Message-----

From: Candace Nachman [mailto:Candace.Nachman@noaa.gov]
Sent: Thursday, November 06, 2008 7:16 AM
To: Evans, Rhys M Civ USAF AFSPC 30CES/CEVNN
Cc: Monica DeAngelis
Subject: Re: Vandenberg status check (another one)

Dear Rhys,

Thank you for sending this email reminder. I'm sorry I hadn't gotten back to you sooner.

I have reviewed the letter you submitted to our office regarding the HTV activity. Based on the information provided in that letter regarding the launch azimuth and projected path of the launch vehicle, it appears that there will not be a sonic boom of greater than 1 psf over San Miguel Island. Since your regulations only require monitoring at SMI when a sonic boom of greater than 1 psf is expected, monitoring for this particular launch activity is not required on the Island. However, you all are still required to conduct the necessary monitoring on Vandenberg, as required by the regulations.

If you have any further questions or concerns about this particular activity, please do not hesitate to contact me via email or the phone.

Candace

APPENDIX B

SPECIES OF CONCERN AND OTHER PROTECTED SPECIES ON SOUTH VANDENBERG AFB, CA

Table B-1. Species of Concern and Other Protected Species Potentially Occurring Near the Commercial Spaceport on South Vandenberg AFB, CA[1]					
Common Name	**Scientific Name**	**Federal Status**	**CA Status**	**Habitat**	**Known Locations on Base**
Plants					
Black flowered figwort	*Scrophularia atrata*	-	SOC	Coastal sage scrub, chaparral	Widespread on base
Sand mesa (shagbark) manzanita	*Arctostaphylos rudis*	-	SOC	Chaparral	Widespread on base
Straight-awned spineflower	*Chorizanthe rectispina*	-	SOC	Chaparral, coastal scrub	
Dune larkspur	*Delphinium parryi* ssp *blochmaniae*	-	SOC	Chaparral, coastal dunes	
Kellog's horkelia	*Horkelia cuneata* ssp *sericea*	-	SOC	Chaparral, coastal scrub	Widespread on base
Reptiles/Amphibians					
Western spadefoot toad	*Scaphiopus hammondii*	-	SOC	Grassland, vernal pools	Dormant underground during dry season
Southwestern pond turtle	*Clemmys marmorata pallida*	-	SOC	Perennial lakes, ponds, streams; eggs laid in upland areas near water	Hatchlings overwinter in nest; move to aquatic sites March-April
California horned lizard	*Phrynosoma coronatum frontale*	-	SOC	Most habitats with loose substrates for burrowing	
Silvery legless lizard	*Anniella pulchra pulchra*	-	SOC	Sparsely vegetated coastal scrub and chaparral	
Birds [1]					
Ferruginous hawk	*Buteo regalis*	-	SOC	Open country	
Western burrowing owl	*Athene cunicularia hypugea*	SOC	SOC	Open, dry grassland	
Loggerhead shrike	*Lanius ludovicianus*	SOC	SOC	Semi-open country with posts, wires, trees, scrub	
Bell's sage sparrow	*Amphispiza belli belli*	-	SOC	Open chaparral	Associated with successional (burned) habitat
Golden eagle	*Aquila chrysaetos*	FP	SOC	Cliffs, large trees in open areas	
Ashy storm-petrel	*Oceanodroma homochroa*	SOC	SOC	Rock outcrops, coastal bluffs	
Northern harrier	*Cicus cyaneus*	-	SOC	Open grassland, coastal sage scrub, marshes, agricultural areas	

Table B-1. Species of Concern and Other Protected Species Potentially Occurring Near the Commercial Spaceport on South Vandenberg AFB, CA[1]					
Common Name	**Scientific Name**	**Federal Status**	**CA Status**	**Habitat**	**Known Locations on Base**
Osprey	*Pandion haliaetus*	-	SOC	Lakes, ponds, sloughs, river mouths, nearshore ocean waters	
Merlin	*Falco columbarius*	-	SOC	Open grassland, agricultural areas, sloughs, and beaches	
Black oystercatcher	*Haematopus bachmani*	SOC	-	Rock outcrops, coastal bluffs	
Rhinoceros auklet	*Cerorhinca monocerata*	-	SOC	Rock outcrops, coastal bluffs	
Black-chinned sparrow	*Spizella atrogularis*	SOC	-	Scrub habitats	
Mammals (includes near-shore waters)					
California sea lion	*Zalophus californianus*	MMPA	-	Coastal waters and rocky shorelines	Point Sal, Point Pedernales, Point Arguello, and Rocky Point haul-out sites
Pacific harbor seal	*Phoca vitulina richardsi*	MMPA	-	Coastal waters and rocky shorelines	Most haul-out sites along the base coastline
Northern elephant seal	*Mirounga angustirostris*	MMPA	-	Coastal waters and rocky shorelines	Occasional visitor to South Base haul-out sites, including Rocky Point
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii*	-	SOC	Rocky outcroppings, man-made structures	Upper Honda Canyon, Swordfish Cave, and Shuman Creek
Pallid bat	*Antrozous pallidus*	-	SOC	Rocky outcroppings, arid caves, man-made structures	Upper Honda Canyon, Swordfish Cave, 13th & Santa Ynez River
San Diego desert woodrat	*Neotoma lepida intermedia*	-	SOC	Coastal sage scrub, prickly pear cactus	

Notes:

[1] For a list of threatened and endangered species, refer to Table 3-5 in the EA.

SOC = Species of Concern

FP = Fully Protected

MMPA = Protected under the Marine Mammal Protection Act

Source: USAF, 2006

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APPENDIX C

SPECIAL STATUS SPECIES OCCURING ON LAND AND WITHIN THE SHALLOW WATERS OF THE REPUBLIC OF THE MARSHALL ISLANDS

Table C-1. Special Status Species Occurring on Land and within the Shallow Waters of the Republic of the Marshall Islands		
Common Name	**Scientific Name**	**Status**
Marine Mammals		
Dugong	*Dugong dugon*	E
Birds		
Ratak Micronesian Pigeon	*Ducula oceania ratakensis*	RS
Mottled Petrel	*Pterodroma inexpectata*	MBCA
Wedge-Tailed Shearwater	*Puffinus pacificus*	MBCA
Sooty Shearwater	*Puffinus griseus*	MBCA
White-Tailed Tropicbird	*Phaethon lepturus*	MBCA
Red-Tailed Tropicbird	*Phaethon rubricauda*	MBCA
Brown Booby	*Sula leucogaster*	MBCA
Red-Footed Booby	*Sula sula*	MBCA
Great Frigatebird	*Fregata minor*	MBCA
Pacific Reef Heron	*Egretta sacra*	MBCA
Cattle Egret	*Bubulcus ibis*	MBCA, CITES
Canada Goose	*Branta canadensis*	MBCA
Green-Winged Teal	*Anas crecca*	MBCA, CITES
Mallard	*Anas platyrhynchos*	MBCA
Northern Pintail	*Anas acuta*	MBCA, CITES
Garganey	*Anas querquedula*	MBCA, CITES
Northern Shoveler	*Anas clypeata*	MBCA, CITES
Tufted Duck	*Aythya fuligula*	MBCA
Black-Bellied Plover	*Pluvialis squatarola*	MBCA
Lesser Golden-Plover	*Pluvialis dominica*	MBCA
Mongolian Plover	*Charadrius mongolus*	MBCA
Common Ringed or	*Charadrius hiaticula*	MBCA
Semipalmated Plover	*Charadrius semipalmatus*	MBCA
Greater Yellowlegs	*Tringa melanoleuca*	MBCA
Lesser Yellowlegs	*Tringa flavipes*	MBCA
Marsh Sandpiper	*Tringa stagnatilis*	MBCA
Wood Sandpiper	*Tringa glareola*	MBCA
Wandering Tattler	*Heteroscelus incanus*	MBCA
Grey-Tailed Tattler	*Heteroscelus brevipes*	MBCA
Whimbrel	*Numenius phaeopus*	MBCA
Bristle-Thighed Curlew	*Numenius tahitiensis*	MBCA
Black-Tailed Godwit	*Limosa limosa*	MBCA
Hudsonian Godwit	*Limosa haemastica*	MBCA
Bar-Tailed Godwit	*Limosa lapponica*	MBCA
Ruddy Turnstone	*Arenaria interpres*	MBCA
Sanderling	*Calidris alba*	MBCA
Pectoral Sandpiper	*Calidris melanotos*	MBCA
Sharp-Tailed Sandpiper	*Calidris acuminata*	MBCA
Curlew Sandpiper	*Calidris ferruginea*	MBCA
Ruff	*Philomachus pugnax*	MBCA
Franklin's Gull	*Larus pipixcan*	MBCA
Black-Naped Tern	*Sterna sumatrana*	MBCA

Table C-1. Special Status Species Occurring on Land and within the Shallow Waters of the Republic of the Marshall Islands

Common Name	Scientific Name	Status
Little Tern	*Sterna albifrons*	MBCA
Sooty Tern	*Sterna fuscata*	MBCA
Brown Noddy	*Anous stolidus*	MBCA
Black Noddy	*Anous minutus*	MBCA
White Tern	*Gygis alba*	MBCA
Great Crested Tern	*Sterna bergii*	MBCA
Fork-Tailed Swift	*Apus pacificus*	MBCA
Long-tailed Cuckoo	*Eudynamis taitensis*	MBCA
Sea Turtles		
Green Sea Turtle	*Chelonia mydas*	T, RS
Loggerhead Sea Turtle	*Caretta caretta*	T, RS
Olive Ridley Sea Turtle	*Lapidochelys olivacea*	T, RS
Leatherback Sea Turtle	*Dermochelys coriacea*	E, RS
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E, RS
Fish		
Napoleon wrasse	*Cheilinus undulatus*	SOC
Giant grouper	*Epinephalus lanceolatus*	SOC
Giant coral trout	*Plectropomus laevis*	SOC
Mollusks		
Top Shell Snail	*Trochus niloticus*	RS
Top Shell Snail	*Trochus maximus*	RS
Giant Clam	*Tridacna gigas*	CITES
Giant Clam	*Tridacna maxima*	CITES
Giant Clam	*Tridacna squamosa*	CITES
Giant Clam	*Tridacna spp.*	CITES
Giant Clam	*Hippopus hippopus*	CITES
Giant Finger Shell	*Lambis truncata*	CITES
Spider Conch Shell	*Lambis scorpius*	CITES
Black-Lip Mother of Pearl Oyster	*Pinctada margaritifera*	RS
Sponges		
All sponge species occurring within the RMI		RS
Coral		
Various coral species listed in Table 3-4G.1 of the UES		CITES

Notes:

E = Endangered
T = Threatened
RS = Protected under RMI Statute
MBCA = Protected under the Migratory Bird Conservation Act
CITES = Protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora
SOC = Species of Concern

Source: USASMDC/ARSTRAT, 2006.

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APPENDIX D

AIR EMISSIONS METHODOLOGY AND CALCULATIONS

D.1 METHODOLOGY

All HTV-2 program related direct and indirect emissions of criteria pollutants for site modifications, pre-launch preparations (including local rocket motor transportation), launch, and post-launch activities at Vandenberg AFB were estimated. Detailed methodologies and emission calculations for each phase of activities are contained herein.

D.1.1 Site Modification Equipment Emissions

Pollutant emissions resulting from activities associated with site modifications were estimated. Site modifications can include use of various vehicles and equipment, including portable generators, forklifts, air compressors, cranes, and trucks. Emissions from the site modification activities were estimated based on the projected activity schedule, the number of vehicles/pieces of equipment, and vehicle/equipment utilization rates (Table D-1). Emission factors for heavy-duty diesel equipment were obtained from CARB's Off-road Mobile Source Emission Factors (CARB, 2008b). The following formula was used to calculate hourly emissions from non-road engine sources, including cranes, forklifts, and the like:

E	=	n x EF
where		
E	=	emission in pounds (lb)/day
n	=	hours/day of equipment operation
EF	=	off-road mobile source emission factor in lb/hour

D.1.2 On-road Vehicle Operations

The emissions due to site modification worker commutes, employee vehicle, and delivery/service trucks used were included in the analysis. Emission factors for motor vehicles were taken from the CARB's On-Road Emission Factors (CARB, 2008a). A sample calculation for the annual emission rate for NO_X from an on-road vehicle is presented below:

Additional employees	=	50
Number of trips/day	=	2
Number of days/year	=	80
Average vehicle commute distance	=	35 miles
On-road emission factor	=	0.001 lb/mile
Annual emission level	=	50 x 2 x 80 x 35 x 0.001/2000 lb/ton
	=	0.14 ton/year

D.1.3 Emissions from Paints, Architectural Coatings, and Adhesives

Emission factors relating emissions to total square footage (sqft) were used to estimate VOC emissions from architectural coating activities, primarily painting, and from launch vehicle assembly activities. VOC content was obtained from SBCAPCD Rules 323 (*Architectural Coatings*) and 353 (*Adhesives and Sealants*) (SBCAPCD, 1999, 2001). The following formula was used to calculate emissions from such activities:

Table D-1. Site Modification Emissions

Equipment Use

Equipment Type	Units	Days	Hours/Day	Hours
Forklifts Composite	1	30	7	210
Other Material Handling Equipment Composite	1	30	7	210

Equipment Emission Factors (lb/hour)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Forklifts Composite	0.2422	0.5982	0.0799	0.0006	0.0324	0.0324	54.4
Other Material Handling Equipment Composite	0.6041	1.7655	0.1952	0.0015	0.0786	0.0786	141.2

Equipment Emissions (tons)

Equipment	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Forklifts Composite	0.0254	0.0628	0.0084	0.0001	0.0034	0.0034	5.7
Other Material Handling Equipment Composite	0.0634	0.1854	0.0205	0.0002	0.0083	0.0083	14.8
Total Equipment Emissions	0.0889	0.2482	0.0289	0.0002	0.0117	0.0117	20.5

Painting

VOC Content	1.25	lb/gal
Coverage	400	sqft/gal
Emission Factor	0.003125	lb/sqft

Building/Facility	Surface Area [sqft]	VOC [lb]	VOC [tons]
Building 1900	5000	15.625	0.0078125
Total	5000	15.625	0.0078125

Delivery of Equipment, Supplies, and Services

Number of Deliveries	1
Number of Trips	2
Miles / Trip	30
Days of Site Modifications	30
Total Miles	1800

Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007	2.7
Total Emissions (lb)	39.51	42.68	5.39	0.05	1.54	1.33	4895.0
Total Emissions (tons)	0.0198	0.0213	0.0027	0.0000	0.0008	0.0007	2.4

Worker Commutes

Number of Workers	10
Number of Trips	2
Miles / Trip	30
Days of Site Modifications	30
Total Miles	18000

Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001	1.1
Total Emissions (lb)	189.87	19.85	19.43	0.19	1.53	0.95	19791.6
Total Emissions (tons)	0.0949	0.0099	0.0097	0.0001	0.0008	0.0005	9.9

Site Modification Emissions Roll-Up (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Equipment	0.0889	0.2482	0.0289	0.0002	0.0117	0.0117	20.5
Painting	0.0000	0.0000	0.0078	0.0000	0.0000	0.0000	0.0
Delivery of Equipment, Supplies, and Services	0.0198	0.0213	0.0027	0.0000	0.0008	0.0007	2.4
Worker Commutes	0.0949	0.0099	0.0097	0.0001	0.0008	0.0005	9.9
Total Site Modification Emissions	**0.2036**	**0.2795**	**0.0491**	**0.0003**	**0.0132**	**0.0128**	**32.9**

Sources: CARB, 2008a, 2008b; SBCAPCD, 2001.

E = [(F x G) / 1000] x H
where
E = emissions of VOCs from architectural coatings
F = lb of VOC emissions/gallon (gal)
G = total area to be coated in sqft
H = paint or coating coverage in sqft/gal

A sample calculation for architectural coating VOC emissions during modifications of an example facility is provided below:

E = 0.83 [lb/gal] x 100,000 [sqft] / 400 [sqft/gal] / 2,000 [lb/ton]
= 0.104 tons

D.1.4 Emissions from Helicopter Operations

Emission factors relating emissions to total helicopter operations on the day of the launch were estimated. Emission factors were taken from the Emissions and Dispersion Modeling System (EDMS) v. 5.0.2 (FAA, 2009). Although the exact type of aircraft to make the safety sweeps is not specified at this time, the UH-1N helicopter was used for the emission calculations. These activities and their associated emissions are extremely limited and no substantial change is expected regardless of what aircraft is used. The following formula was used to calculate emissions from the helicopters:

E = EF x N
where
E = Helicopter emissions
EF = Emission per operation (landing and take-off [LTO] or 90 minute flight)
N = Number of Operations

A sample calculation for helicopter emissions from 20 flights is provided below:

E = 1.30 [lb/operation] x 20 [operations] / 2000 [lb/ton]
= 0.0130 tons of emissions

D.1.5 Emissions from the Minotaur IV Lite Booster

The Minotaur IV Lite uses the same three-stage booster as a Peacekeeper ICBM (SR-118, SR-119, and SR-120 motors). Emissions for the Minotaur IV Lite booster were developed from fuel chemistry and molar fractional analysis of the solid rocket propellant used in the Peacekeeper booster (SMC Det 12/RPD, 2005, 2006). The following formula was used to calculate emissions from the launch vehicle:

E = %M x T
where
E = Booster emissions
%M = Percentage in the products of combustion
T = Total mass of propellant

A sample calculation for CO_2 from the launch vehicle is provided below:

E_{CO2} = 2.44 [%CO_2] x 16400 [lb of propellant] / 2000 [lb/ton]
= 0.2 tons CO_2

D.2 EMISSION ESTIMATIONS

D.2.1 Site Modifications, Rocket Motor Transportation, and Pre-Launch Preparations

All direct and indirect emissions of criteria pollutants for the site modifications and pre-launch preparations (including local rocket motor transportation) were estimated (Table D-2). Air emissions for pre-launch activities would include:

- Combustive emissions from equipment used for Building 1900 modifications
- Painting/corrosion control efforts from refurbishing activities at Building 1900
- Emissions from delivery of equipment, supplies, and services
- Employee commuting during facility modifications, pre-launch, and post-launch activities
- Emissions from transporting booster motors, components, and equipment to Vandenberg AFB
- Emissions from transporting the HTV-2 vehicles and equipment to the launch site
- Use of solvent/paints/adhesives during launch vehicle integration

D.2.2 Launch Activities

In the hours before the launch, helicopters (as well as remote sensors) could be used to verify that the hazard areas are clear of non-mission-essential aircraft, vessels, and personnel. All direct and indirect emissions of criteria pollutants for the helicopter exhaust emissions and from the Minotaur IV Lite booster for one launch were estimated (Table D-3). In addition to criteria pollutants, the products of combustion from the booster would also include other common products of combustion including aluminum oxide, hydrogen chloride, hydrogen, nitrogen, carbon dioxide, and water.

D.2.3 Post-Launch Operations

In the hours and days following each launch, a general safety check and cleanup of the launch site would occur. All direct and indirect emissions of criteria pollutants for worker commutes, the removal of equipment from the launch sites, and general refurbishment of launch facilities were estimated (Table D-4).

D.2.4 Overall Project Emissions

All direct and indirect emissions of criteria pollutants for the site modifications, pre-launch preparations (including local rocket motor transportation), launch, and post-launch activities were estimated (Table D-5). Under the Proposed Action, two HTV-2 flight tests would occur, with the possibility of both launches occurring in the same year. This analysis included all pre-launch, launch, and post-launch activities for two full launch cycles, plus building modifications, as a worst-case scenario.

Table D-2. Pre-launch Emissions for a Single Launch							
Delivery of Equipment, Supplies, and Services to Vandenberg AFB							
Number of Deliveries	1						
Number of Trips	2						
Miles / Trip	30						
Days of Assembly	90						
Total Miles	5400						
Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007	2.7
Total Emissions (lb)	118.53	128.05	16.16	0.14	4.62	3.99	14684.9
Total Emissions (tons)	0.0593	0.0640	0.0081	0.0001	0.0023	0.0020	7.3
Delivery of Equipment, Supplies, and Services to the Launch Site							
Number of Deliveries	1						
Number of Trips	2						
Miles / Trip	5						
Days of Delivery to Launch Site	2						
Total Miles	20						
Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007	2.7
Total Emissions (lb)	0.44	0.47	0.06	0.00	0.02	0.01	54.4
Total Emissions (tons)	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	57.1
Use of Adhesives During Assembly							
VOC Content	3.5	lb/gal					
Coverage	150	sqft/gal					
Emission Factor	0.07	lb/sqft					
Activities	Surface Area [sqft]	VOC [lb]	VOC [tons]				
Assembly	200	4.7	0.0023				
Total	200	**4.7**	**0.0023**				
Crane Use at Launch Site							
Equipment Type	Units	Days	Hrs/Day	Hours			
Crane	1	10	4	40			
Pollutant	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor	0.6011	1.6100	0.1778	0.0014	0.0715	0.0715	128.7
Total Emissions (tons)	0.0120	0.0322	0.0036	0.0000	0.0014	0.0014	2.6
Worker Commutes							
Number of Workers	20						
Number of Trips	2						
Miles / Trip	30						
Days of Pre-launch	90						
Total Miles	108000						
Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001	1.1
Total Emissions (lb)	1139.23	119.11	116.55	1.16	9.19	5.72	118749.5
Total Emissions (tons)	0.5696	0.0596	0.0583	0.0006	0.0046	0.0029	59.4
Pre-launch Emission Roll-Up (tons)							
Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Delivery of Equipment, Supplies, and Services to Vandenberg AFB	0.0593	0.0640	0.0081	0.0001	0.0023	0.0020	7.3
Delivery of Equipment, Supplies, and Services to the Launch Site	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	57.1
Use of Adhesives During Assembly	0.0000	0.0000	0.0070	0.0000	0.0000	0.0000	0.0
Crane Use at Launch Site	0.0120	0.0322	0.0036	0.0000	0.0014	0.0014	2.6
Worker Commutes	0.5696	0.0596	0.0583	0.0006	0.0046	0.0029	59.4
Total Pre-launch Emissions	**0.6411**	**0.1560**	**0.0769**	**0.0007**	**0.0083**	**0.0063**	**126.4**

Sources: CARB, 2008a, 2008b; SBCAPCD, 1999.

Table D-3. Flight Activity Emissions for a Single Launch

Helicopter Emissions

Number of Flights	2					
	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
LTO Emission Factors (lb/operation)	1.120	7.350	0.24	1.72	0.146	0.146
LTO Emission (tons)	0.0011	0.0073	0.0002	0.0017	0.0001	0.0001
Flight Emission Factors (lb/operation)	2.97	7.59	0.33	0.00	0.000	0.000
Flight Emissions (tons)	0.00297	0.00759	0.00033	0	0	0
Total (tons)	**0.0041**	**0.0149**	**0.0006**	**0.0017**	**0.0001**	**0.0001**

Launch Emissions

Avg SR-120 Prop Mass (pound-mass [lbm])	15584
Avg SR-119 Prop Mass (lbm)	54138
Avg SR-118 Prop Mass (lbm)	98462

	Molar Mass (grams)	SR-118 (%M)	SR-118 (tons)	SR-119 (%M)	SR-119 (tons)	SR-120 (lb)	SR-120 (tons)	Total (tons)
Aluminum Oxide (solid) (Al_2O_3)	101.96	35.89%	17.67	4.32%	9.72	5005.18	2.50	29.89
Carbon Monoxide (CO)	*28.01*	*22.13%*	10.89	*23.21%*	5.99	5521.32	2.76	19.65
Carbon Dioxide (CO_2)	44.01	2.44%	1.20	1.05%	0.66	258.70	0.13	1.99
Hydrogen Chloride (HCl)	36.46	21.21%	10.44	15.74%	5.74	238.98	0.12	16.30
Water (H_2O)	18.02	7.45%	3.67	8.30%	2.02	506.75	0.25	5.94
Hydrogen (H_2)	2.02	2.23%	1.10	32.63%	0.60	349.78	0.17	1.88
Nitrogen (N_2)	28.01	8.38%	4.13	7.99%	2.27	3774.91	1.89	8.28
Other Misc		0.27%	0.13	6.76%	0.07	0.00	0.00	0.21
Total		100.00%	**49.23**	100.00%	**27.07**	15655.62	7.83	**84.13**

Total Launch Emissions (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$
Helicopter Emissions	0.0041	0.0149	0.0006	0.0017	0.0001	0.0001
Launch Emissions	19.6458	0.0000	0.0000	0.0000	6.1566	4.2977
Total Launch Emissions	**19.6499**	**0.0149**	**0.0006**	**0.0017**	**6.1568**	**4.2978**

Sources: FAA 2007; SMC Det 12/RPD, 2005, 2006.

Note: Launch PM_{10} and $PM_{2.5}$ emissions are assumed to be 10.3 and 7.2 percent total Al_2O_3 respectively.

Table D-4. Post-launch Emissions for a Single Launch

Removal of Equipment

Number of Removals	2						
Number of Trips	2						
Miles / Trip	10						
Days of Breakdown	10						
Total Miles	400						
Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0219	0.0237	0.0030	0.0000	0.0009	0.0007	2.7
Total Emissions (lb)	8.78	9.49	1.20	0.01	0.34	0.30	1087.8
Total Emissions (tons)	0.0044	0.0047	0.0006	0.0000	0.0002	0.0001	0.5

Worker Commutes

Number of Workers	20						
Number of Trips	2						
Miles / Trip	30						
Days of Breakdown	10						
Total Miles	12000						
Pollutant (lb/mile)	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Emission Factor (lb/mile)	0.0105	0.0011	0.0011	0.0000	0.0001	0.0001	1.1
Total Emissions (lb)	126.58	13.23	12.95	0.13	1.02	0.64	13194.4
Total Emissions (tons)	0.0633	0.0066	0.0065	0.0001	0.0005	0.0003	6.6

Painting

VOC Content	1.25	lb/gallon (gal)	
Coverage	400	sqft/gal	
Emission Factor	0.003125	lb/sqft	
Building/Facility	Surface Area [sqft]	VOC [lb]	VOC [tons]
Launch Facility	5000	15.625	0.0078
Total	5000	15.625	0.0488

Total Post-launch Emissions (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Removal of Equipment	0.0044	0.0047	0.0006	0.0000	0.0002	0.0001	0.5
Worker Commutes	0.0633	0.0066	0.0065	0.0001	0.0005	0.0003	6.6
Painting	0.0000	0.0000	0.0488	0.0000	0.0000	0.0000	0.0
Total Post-launch Emissions	0.0677	0.0114	0.0559	0.0001	0.0007	0.0005	7.1

Sources: CARB, 2008a, 2008b; SBCAPCD, 2001.

Table D-5. Roll-up of All Direct and Indirect Emissions Associated with the Proposed Action

Total Site Modification Emissions (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment	0.0889	0.2482	0.0289	0.0002	0.0117	0.0117	20.5
Painting	0.0000	0.0000	0.0078	0.0000	0.0000	0.0000	0.0
Delivery of Equipment, Supplies, and Services	0.0198	0.0213	0.0027	0.0000	0.0008	0.0007	2.4
Worker Commutes	0.0949	0.0099	0.0097	0.0001	0.0008	0.0005	9.9
Total Construction Emissions	0.2036	0.2795	0.0491	0.0003	0.0132	0.0128	32.9

Total Pre-launch Emissions for a Single Launch (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Delivery of Equipment, Supplies, and Services to Vandenberg AFB	0.0593	0.0640	0.0081	0.0001	0.0023	0.0020	7.3
Delivery of Equipment, Supplies, and Services to the Launch Site	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	57.1
Use of Adhesives During Assembly	0.0000	0.0000	0.0070	0.0000	0.0000	0.0000	0.0
Crane Use at Launch Site	0.0120	0.0322	0.0036	0.0000	0.0014	0.0014	2.6
Worker Commutes	0.5696	0.0596	0.0583	0.0006	0.0046	0.0029	59.4
Total Pre-launch Emissions	0.6411	0.1560	0.0769	0.0007	0.0083	0.0063	126.4

Total Launch Emissions for a Single Launch (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Helicopter Emissions	0.0041	0.0149	0.0006	0.0017	0.0001	0.0001	0.0
Launch Emissions	19.6458	0.0000	0.0000	0.0000	6.1566	4.2977	2.0
Total Launch Emissions	19.6499	0.0149	0.0006	0.0017	6.1568	4.2978	2.0

Total Post-launch Emissions for a Single Launch (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Removal of Equipment	0.0044	0.0047	0.0006	0.0000	0.0002	0.0001	0.5
Worker Commutes	0.0633	0.0066	0.0065	0.0001	0.0005	0.0003	6.6
Painting	0.0000	0.0000	0.0488	0.0000	0.0000	0.0000	0.0
Total Post-launch Emissions	0.0677	0.0114	0.0559	0.0001	0.0007	0.0005	7.1

Emissions for Entire Proposed Action for Two Launches (tons)

Activity/Source	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Construction	0.204	0.279	0.049	0.000	0.013	0.013	32.9
Pre-launch	1.282	0.312	0.145	0.001	0.017	0.013	252.8
Launch	39.300	0.030	0.001	0.003	12.314	8.596	4.0
Post-launch	0.135	0.023	0.112	0.000	0.001	0.001	14.3
TOTAL EMISSIONS	**40.921**	**0.644**	**0.307**	**0.005**	**12.345**	**8.622**	**303.9**

D.3 REFERENCES

California Air Resources Board (CARB). 2008a. *EMFAC 2007 (v2.3) Emission Factors (On-Road)*. URL: http://www.aqmd.gov/CEQA/handbook/onroad/onroad.html, accessed February 19, 2009.

California Air Resources Board (CARB). 2008b. *EMFAC 2007 (v2.3) Emission Factors (Off-Road)*. URL: http://www.aqmd.gov/CEQA/handbook/offroad/offroad.html, accessed February 19, 2009.

Federal Aviation Administration (FAA). 2009. *Emissions and Dispersion Modeling System (EDMS)*. URL: http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/, accessed February 19, 2009.

Santa Barbara County Air Pollution Control District (SBCAPCD). 1999. SBCAPCD Rule 353 (*Adhesives and Sealants*). URL: http://www.sbcapcd.org/rules/dlrules.htm, accessed February 19, 2009.

Santa Barbara County Air Pollution Control District (SBCAPCD). 2001. SBCAPCD Rule 323 (*Architectural Coatings*). URL: http://www.sbcapcd.org/rules/dlrules.htm, accessed February 19, 2009.

Space and Missile Systems Center, Detachment 12/RPD (SMC Det 12/RPD). 2005. Electronic communication, data, and information. September 13 and 22.

Space and Missile Systems Center, Detachment 12/RPD (SMC Det 12/RPD). 2006. Electronic communication and information. June 16.

APPENDIX E

SONIC BOOM METHODOLOGY

The HTV-2 vehicle sonic booms were analyzed for: (1) carpet booms during horizontal flight over the Pacific Ocean and (2) focused booms during vehicle descent just prior to impact in the BOA near USAKA/RTS. Modeling was based on sonic boom code known as PCBoom3 and developed by K.J. Plotkin of Wyle Laboratories.

The inputs to PCBoom3 include trajectory data and atmospheric data. For vehicle aerodynamics, built in body shapes were used. For modeling purposes, it was assumed that the shape of the HTV-2 vehicle would fall in between a blunt lifting body and a supersonic transport body shape. Thus, modeling results included both body shapes.

Outputs from PCBoom3 are isopemps (focused pressure areas), which translate into peak overpressure footprints. Peak overpressures represent the highest overpressure experienced at a particular location. Figures E-1 and E-2 show resulting overpressure footprint contours for focused booms near the point of ocean impact in the BOA.

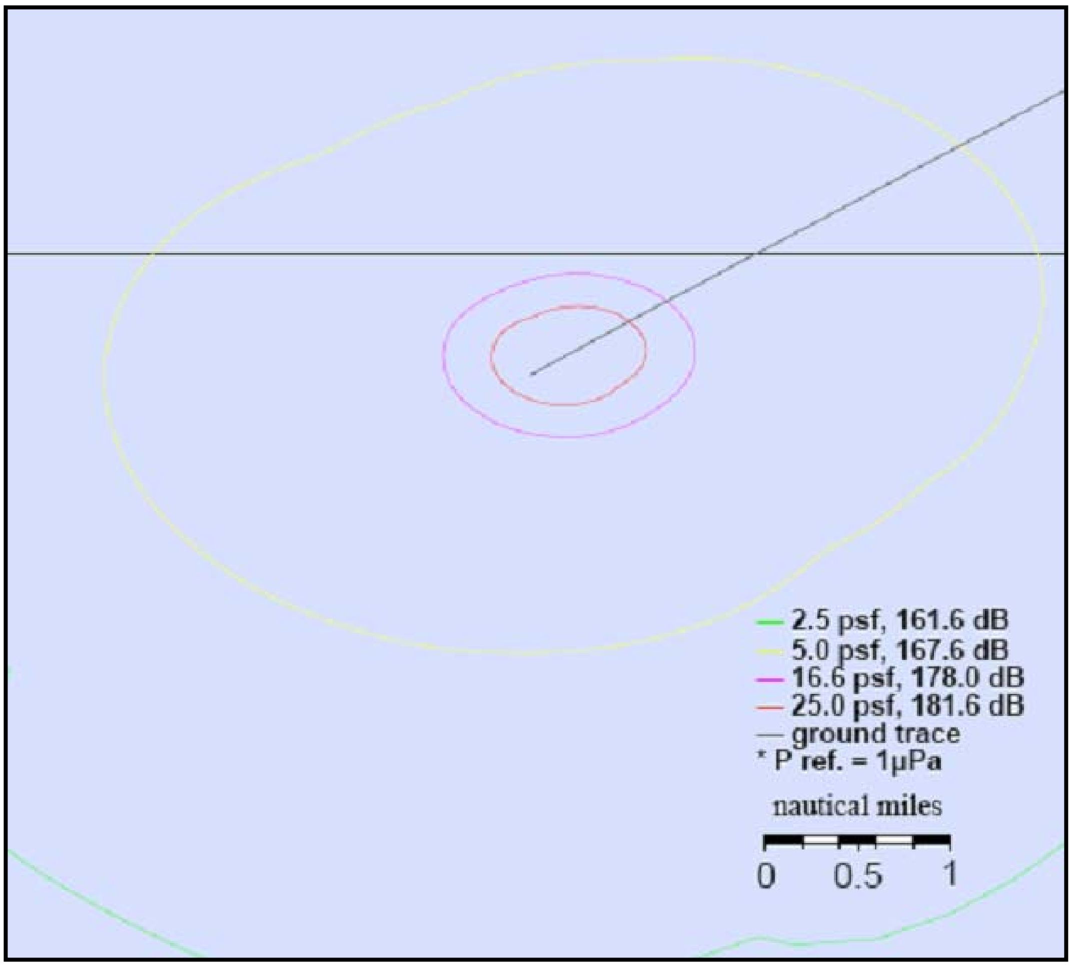

Figure E-1. Overpressure Contours for a Blunt Lifting Body Shape at an Altitude of 91,000 Feet to Ocean Impact

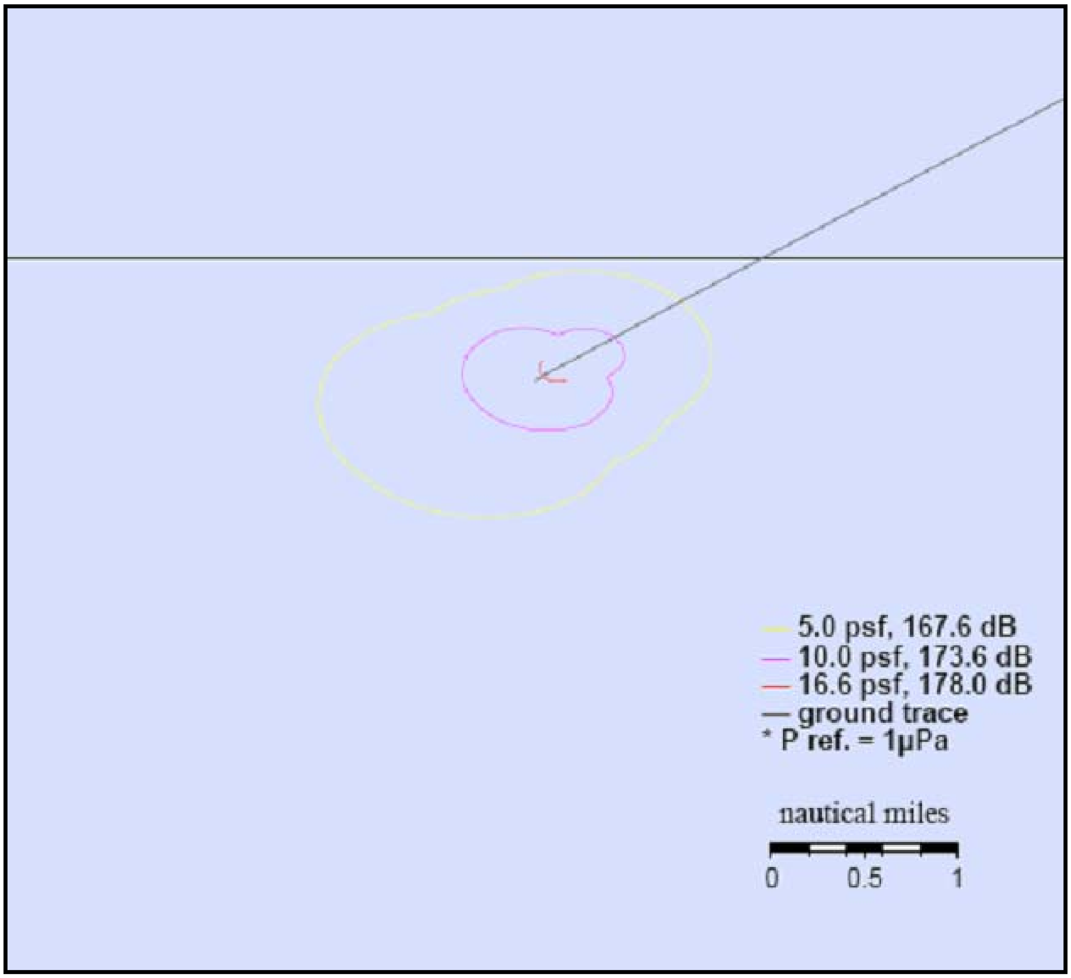

Figure E-2. Overpressure Contours for a Supersonic Transport Body Shape at an Altitude of 91,000 Feet to Ocean Impact

As the two figures show, the more aerodynamic supersonic transport body shape (Figure E-2) produces lower overpressures at the surface than the blunt shaped body (Figure E-1). For purposes of sonic boom analyses for the HTV-2 vehicle, an average of the resulting overpressures from the two body shapes was used. Table E-1 summarizes carpet boom modeling results and averages for locations in the over-ocean flight corridor and in the Marshall Islands based on the HTV-2 Mission A flight path trajectory data only. Mission B carpet boom values were extrapolated from the Mission A results. Table E-2 summarizes focused boom modeling results in the BOA for the HTV-2 Mission A trajectory only. It is expected that the Mission B focused boom would have similar results.

Table E-1. Carpet Boom Overpressure Calculations (psf)

Location	Blunt Body	Supersonic Transport Body	Average used for HTV-2
Mission A Flight Path			
Peak for Ground Trace	0.252	0.163	0.21
NWHI	0.20	0.10	0.15
Bikar Atoll	0.226	0.133	0.18
Taka Atoll	0.14	0.10	0.12
Utirik Atoll	0.13	0.10	0.12
Mission B Flight Path*			
Peak for Ground Trace	0.252	0.163	0.21
Wake Island	0.20	0.10	0.15
Rongelap Atoll	0.13	0.10	0.12
Rongerik Atoll	0.226	0.133	0.18

* Overpressures were extrapolated from Mission A flight path results.

Table E-2. Focused Boom Overpressure Calculations (psf)

Location	Blunt Body	Supersonic Transport Body	Average used for HTV-2
Maximum Overpressure (near impact point)	34.2	17.8	26.0
Minimum Overpressure (outer most contour)	0.10	0.02	0.06

References:

Space and Missile Systems Center (SMC). 2008. Overpressure from Sonic Boom Generated by Falcon Hypersonic Test Vehicle 2. January 28.

Wang, J.C.T., C.P. Griffice, J.R. Edwards, and A.A. Hashad. 2008. “Underwater Overpressure from Hypervelocity Sonic Booms.” 29th American Institute for Aeronautics and Astronautics (AIAA) Aeroacoustics Conference, presented May 5.

APPENDIX F

COMMENTS AND RESPONSES ON THE DRAFT ENVIRONMENTAL ASSESSMENT

Comments and Responses on the Draft Environmental Assessment for Hypersonic Technology Vehicle 2 Flight Tests

This appendix contains a photocopy of the comment documents received on the Draft Environmental Assessment (EA). During review of the Draft EA, the DARPA and USAF received only one comment letter. In the following letter, comment numbers have been added along the right margin and are numbered sequentially. A corresponding list of comment responses is provided immediately following the letter. Note that in addition to the comment responses, the text of the Final EA has been revised, as appropriate, to reflect the concerns expressed in the comments.

Our Vision Clean Air

Santa Barbara County
Air Pollution Control District

April 13, 2009

Mr. Thomas Huynh
SMC/EAFV
483 North Aviation Boulevard
El Segundo, CA 90245-2808

Re: APCD Comments on Draft Environmental Assessment (EA) for Hypersonic Technology Vehicle 2 (HTV-2) Flight Tests

Dear Mr. Huynh:

The Santa Barbara County Air Pollution Control District (APCD) has reviewed the Draft Environmental Assessment (EA) for the Hypersonic Technology Vehicle 2 (HTV-2) flight tests to support development and demonstration of hypersonic technologies. Both HTV-2 missions are scheduled to occur during the 2009 calendar year at Vandenberg Air Force Base, California, and both would be launched using existing rocket booster systems. Following booster separation, the HTV-2 would glide at hypersonic velocities in the upper atmosphere, prior to an ocean impact near U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site in the Republic of the Marshall Islands.

APCD staff generally concurs with the findings of the Draft EA that the project will not have a significant impact on the environment, and therefore no mitigations are required. However, APCD would like to emphasize that all operations should be conducted in compliance with APCD rules and permit conditions, and that any emergency/standby generator engines rated at greater than 50 brake-horsepower (BHP) should either have an APCD permit or be registered through the State of California Air Resources Board (CARB) portable equipment registration program (PERP). 1

Specific comments regarding the air quality analysis portion of the EA are offered below:

1. **Table 2.5, Comparison of Potential Environmental Consequences, Page 24**: The discussion of air quality impacts in this table presents air quality emissions as 0.31 tons of volatile organic compounds (VOC) and 21 tons of total particulate matter (PM_{10}). This does not agree with the summary tables in Section 4.1.1.1 (Table 4-2) and in Appendix D (Table D-5), which present project emissions for several criteria pollutants. The value of 21 tons of PM_{10} does not agree with the values in other sections of the document (Tables 4-2 and D-5), where PM_{10} emissions are presented as 12.3 tons total. 2

2. **Table 3-1, Air Quality Standards and Ambient Air Concentrations, Page 29**: The state air quality standards for NO_2 should be updated (1-hour standard is 0.18 ppm; annual arithmetic mean is 0.03 ppm). The federal annual arithmetic mean standard for PM_{10} of 50 $\mu g/m^3$ has been revoked. 3

Terence E. Dressler • Air Pollution Control Officer
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APCD Comments on Draft Environmental Assessment (EA) for Hypersonic Technology Vehicle 2 (HTV-2) Flight Tests
April 13, 2009
Page 2

Thank you for your consideration of our comments. If you have any questions related to the comments, please contact me at 961-8838 or by e-mail at mmp@sbcapcd.org.

Sincerely,

Molly Pearson

Molly Pearson
Air Quality Specialist
Technology and Environmental Assessment Division

cc: Project File
TEA Chron File

RESPONSES TO SANTA BARBARA COUNTY AIR POLLUTION CONTROL DISTRICT COMMENTS (April 13, 2009)

Response to Comment #1

To emphasize that all HTV-2 operations at Vandenberg AFB would comply with SBCAPCD rules and regulations (including permit requirements), discussions on compliance have been expanded in Sections 4.1.1.1.1 and 4.1.1.1.2, in addition to the existing discussions in Section 4.1.1.1.3.

In regards to emergency/standby generator engines, Sections 2.1.2.1.3 and 4.1.1.1.1 of the EA state that the emergency power generator to be used for launch support at Vandenberg AFB would be "permitted by the SBCAPCD or registered under the CARB Portable Equipment Registration Program."

Response to Comment #2

Table 2-5 has been corrected in identifying 12.3 tons (11.2 metric tons) of total particulate matter in association with the Proposed Action at Vandenberg AFB. This information corresponds to the values presented in Table 4-2 and Appendix D (Table D-5) of the EA.

Response to Comment #3

In accordance with current CAAQS and NAAQS, Table 3-1 has been updated for state NO_2 standards and the federal PM_{10} annual arithmetic mean standard was deleted.

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